Mining
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"MINING,"

A JOURNAL DEVOTED TO THE INTERESTS
OF MINERS & MINING STUDENTS.

VOLUME I.---1892-93.

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MINING

A Journal devoted to the interests of Mining.

No. 1. Vol. I. DECEMBER 1ST, 1892. FORTNIGHTLY ONE PENNY.

INTRODUCTION.

THE difficulty of securing a cheap and reliable Journal solely devoted to Mining, has no doubt been the experience of most of the Mining fraternity.

We therefore hope that by issuing a Journal that will contain the practical as well as the theoretical information necessary to persons engaged in Mining, we have overcome that difficulty.

The quantity and quality of the matter that we are giving for the money will not allow us to spend large sums in advertising. We, therefore, trust that our Readers will further the interests of this Journal by introducing it among their Mining friends.

We shall be pleased to forward specimen copies, carriage paid to anyone that will be good enough to apply for them, and also to appoint someone (in the districts where we have no agent) as our agent. Terms, etc., can be had on applying to us.

To increase the value of this Journal we are making preparations to have it illustrated.

SURVEYING.

BY A SURVEYOR.

THE subject of surveying is so closely allied to mining, that the student who wishes to become acquainted with mining matters should certainly not neglect it. Its importance has been recognised by Her Majesty's examiners, and the examinations for certificates now include surveying.

I intend in my articles on this subject to treat it sufficiently to enable those who intend sitting for managers' and undermanagers' certificates to answer correctly that section of the paper. It cannot be expected that surveyors can be made by simply reading articles or books, so I would advise those readers who have the opportunity of so doing, to follow practically the different descriptions of surveying which I shall give from time to time.

Surveying was first done by the Egyptians to enable the different landlords to determine the boundaries of their lands after the periodical overflowing of the Nile river, which swept away all landmarks. A plan of one of these surveys is preserved in an Italian museum, which is dated 600 B.C., thus showing that surveying was practised before mining operations were commenced.

The art of surveying as practised in mines is similar to the manner in

which the mariner with his compass finds out in what part of the globe he is situated, and the dial is simply a modification of the compass. The only difference between these respective systems are, that the mariner uses the chart and the sun together with his compass, and the surveyor makes use of a chain and some known point in conjunction with his dial.

We might now ask the question—

WHAT IS UNDERGROUND SURVEYING?

It is the method by which the relative positions of the roadways in a mine are determined by means of a dial, chain, etc.

By Plotting the survey of the mine on paper it also enables us to calculate the amount of coal gotten, and the position of faults, etc.

There are two distinct methods of surveying which I shall describe—

1st.—Loose Needle Surveying.
2nd.—Fast Needle, or Angling.

The loose needle surveys are made by means of a loose magnetic needle balanced upon a pivot.

I do not think it inappropriate to give here

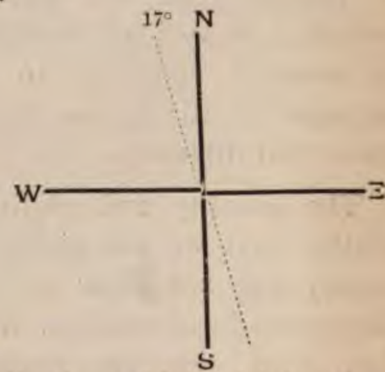
THE PROPERTIES OF A MAGNETIC NEEDLE.

Loadstone is a mineral which has the property of being a natural magnet and is found in many parts of the world. Its composition is three parts of iron to four of oxygen, chemically known as $Fe_3 O_4$. The Chinese discovered that if a piece of loadstone was suspended by a thread from its centre it settled in a line which pointed nearly N. and S. nd this served to guide them in heir travels before 1000 B.C.

If loadstone be rubbed along a piece of hard iron or steel it imparts its peculiar property to the iron or steel, thus making it an artificial permanent magnet, which if allowed free rotation on its centre will settle in a direction known as

MAGNETIC NORTH & SOUTH.

This imaginary line points about 17° N. W. of true Geographical north as shown in diagram, and this difference is known as "The Magnetic Declination." The angle of declination is not constant but varies every year, and is different at different places; it is now receding towards true north at the rate of about $\frac{1}{8}$° each year. This phenomenon was discovered by the Chinese about 900 A.D.



The following table which is taken from Mr. W. Fairley's, "Colliery Manager's Pocket Book," gives the variation of the Magnetic Needle from true north at Greenwich :—

Year.	Variation.	Year.	Variation.
1576	11° 15′ E	1864	20° 40′ W
1657	0 0	1870	19 53 W
1666	1 35 W	1976	19 8 W
1672	2 30 W	1880	18 33 W
1700	8 0 W	1886	17 55 W
1818	24 41 W	1887	17 49 W
1820	24 32 W	1888	17 40 W
1858	21 30 W	1889	17 34 W

(To be continued.)

The gauze of a safety lamp has 784 apertures.
The Davey lamp explodes in fiery gases which have a velocity of 6ft. per second.

METHODS OF WORKING COAL.

LONGWALL.

WHEN a new mine is to be worked, the utmost care and deliberation of the manager is necessary to determine the most efficient and economic method of winning the coal.

There are several ways of doing this; but they are all modifications more or less of two systems, which are known as Longwall and Pillar and Stall. It is with the former that I propose to deal in this article.

Some of the circumstances under which the Longwall method of working are most advantageous are:

1st—A thin hard seam with moderately soft bottom or top, which will require cutting to give the necessary height to the roads, thus furnishing a quantity of debris to pack the wastes.

2nd—A thick band of dirt running between two seams of coal.

3rd—The area of the royalty to be worked not being considerable.

4th—A mine free from water.

5th—An highly inclined seam.

6th—A mine free from faults and dislocations.

7th—No considerable amount of fiery gases being produced.

The advantages of the Longwall method are:—

A greater percentage of round coal is obtained. To my own knowledge, at a mine where both the Pillar and Stall and Longwall methods were tried, twenty per cent. more round coal was gotten from the Longwall workings.

Almost all of the coal can be worked out.

Ventilation is easy and simple. The superincumbent weight on the coal makes it easier to get. The men work with greater safety. The cost of getting the coal is cheaper than by other methods.

Its disadvantages are:—The costs of keeping the roads in repair are more expensive, but this depends materially upon the efficiency with which the roads are first packed. The wastes cannot very well be ventilated. The work must be done regularly, as one working place lagging behind causes much trouble and expense. Faults, etc., are much more difficult to deal with.

(To be continued.)

GEOLOGY.

BY "RETSO."

THE study of Geology gives to us that knowledge, by which we understand the great changes that are going on day by day, and the changes that have gone, and by putting a few facts together, we know how the different formations have been made.

The earliest condition of the earth has had no satisfactory accounting for, several theories have been formed, and each have their respective claims.

But the one that is generally recognised and called

"THE NEBULA THEORY,"

is that the earth was once a mass of incandescent gases and vapours, moving rapidly round the sun.

These gases and vapours began to cool, the outer layer being the atmosphere, and the next the

"CRUST OF THE EARTH."

Water forms ¾ths of the whole planet and would consist of the condensing of the vapour.

The earth being formed by the condensing of the gases.

In support of this theory we know that the inside of the earth is much hotter than the crust—showing that it is a cooling body—by the presence of volcanoes.

Greater and uniform heat as we go into the earth by means of shafts, etc.

HOT SPRINGS,

As Buxton and Bath Springs all tend to show that it must be much hotter in the centre.

The ends or poles of the earth are somewhat flattened, thus proving that they must have been in a somewhat molten state.

The Geological Time as it is called is divided into five devisions known by the names of—

1st—Archaen or Earliest Time.
2nd—Paleozoic or Ancient Life.
3rd—Mesozoic or Middle Life.
4th—Cainozoic or Recent.
5th—Post Tertiary—this is from the time when man first appeared, each of which I shall describe and give their chief characteristics further on in the subject.

The changes that are constantly going on and those of the past will form the subject next for explanation.

HAULING.

IN the days of shallow pits, as soon as the coal in the immediate proximity of the shaft was exhausted, another shaft was sunk at a short distance from the first. We therefore see that to the early miners the conveyance of coal underground was a matter of small consequence.

But in these our modern times when deep and expensive shafts are sunk, as much coal is raised up one shaft as can possibly be done economically. In very many cases the distance from the coal face to the shaft exceeds a mile in length. Under these circumstances the importance of haulage underground cannot now be over estimated.

The primitive method of conveying the coal from the working places to the shaft was by means of baskets, which were filled with the coal, and then carried by women on their shoulders. Wheelbarrows were next used, planks being laid in the centre of the road for the wheel to run upon. This conveyance was not the wheelbarrow as we now know it, but its own peculiar features of a wheel at one end and two handles at the other are identical with it.

Tubs or sledges with iron slides at the bottom, which were also run along planks, were next used, and this was the first commencement of a series of improvements which have for their result the small pit tub, which is in use at the present time. Baskets or corves were again resorted to, but instead of women doing the degrading and laborious work of carrying them, they were placed on trolleys, each trolley holding about six corves, and were drawn to the shaft by horses or ponies. These corves were very clumsy, and did not last for any length of time, so wooden sledges were again used, but they were plaçed on the trolleys in the same manner as the corves. Wheels were then attached to the tubs, but for some considerable time the trolleys were still used to draw them from the main roads to the pit. At last the futility of drawing the weight of the trolleys, the time wasted in putting

the tubs on them, and the expense connected with it was recognised, and caused this system to be abolished for the more convenient one of running the tubs to the shaft on their own wheels.

(To be continued.)

CHEMISTRY IN MINING.

STUDENTS who wish for a practical acquaintance with chemistry and its associations in Mining should read these articles carefully through and do for themselves the simple experiments that will be explained, it will not only impress upon their minds better what gases really are, but give them a knowledge that cannot be got merely from reading books.

The experiments can be performed with the simple apparatus that will be described and will be inexpensive.

The students must become acquainted with the meaning of a few terms, and how the gases have symbols, relative weight, and can be chemically combined and not merely mixed.

Atoms.—An atom is the smallest particle of matter that can exist in a free state and cannot be divided.

Molecules.—A molecule consists of two or more atoms.

Compounds.—When we speak of a compound we mean a mixture, either chemical or mechanical, of two or more elements.

Elements are substances that we cannot separate, we can take an example in metals.

Instead of writing the names of the elements in full they have symbols and the list of a few are here given with their atomic weight. Hydrogen is taken as 1.

Elements.	Symbol.	Atomic Weight.
Carbon	C	12
Chlorine	Cl.	35·5
Hydrogen	H	1
Nitrogen	N	14
Oxygen	O	16

We must now understand the difference between a Mechanical Mixture and a Chemical Combination, the two best illustrations of which are—

1st—Supposing we take one part of Oxygen and one part of Nitrogen, and we mix these together in a Jar, it would merely be a Mechanical Mixture.

2nd—Let us take say two parts of Hydrogen and one part of Oxygen, and apply a light to the mixture, the resultant will be — Water, the chemical formulae for water being H two parts, O one part, written $H_2 O$, this is a

"CHEMICAL COMBINATION."

STEAM & THE STEAM ENGINE.

BEFORE we commence to describe the steam engine proper, it is necessary to possess some knowledge of the properties of steam.

Steam is an invisible, elastic fluid, generated from water by the application of heat.

No doubt some of our readers will be disposed to disprove the statement as to steam being invisible, and will, perhaps, give us an example, that steam may be seen issuing from the exhaust pipe of an engine, or from the spout of a kettle; but let these readers take another look at the so-called steam coming from any such orifice, and it will be noticed that it is invisible close to the pipe, and it is only when it loses part of its heat and becomes vapourised by the atmosphere that it becomes visible, and the moment this occurs it ceases to be steam, and is known as vapour.

That steam is elastic may be proved by filling a cylinder which has a tight fitting movable piston, with steam at 15lbs. pressure. Then by bringing pressure to bear on the piston this steam may be compressed into one-half of its original volume. The pressure necessary to effect this will be 30lbs. on the square inch, or 15lbs. per square inch together with the pressure of the atmosphere, as may be proved by Boyle's or Marriotte's law, viz.:—"The temperature remaining the same, the volume of a given quantity of gas is in inverse ratio to the pressure." So that if the volume be reduced to one-half the pressure will be doubled. In the same manner, if sufficient pressure be used on the piston the steam may be reduced to one quarter or one eight, &c., of its volume, and if this pressure be removed, the steam will expand to its original dimensions, thus showing that it is elastic.

The incident which gave *Watt* the knowledge of the pressure of steam, though perhaps known to most of you, will bear repetition.

He was watching a kettle of water boil, and seeing the repeated lifting f the lid through the force of the steam, the idea came to him that this pressure could be used to perform useful work, and the commercial value of England at the present day is no doubt deeply indebted to this circumstance, which gave a boy the ideas which when developed provided us with essentially the same steam engine that we are using at the present time.

METAL MINING.

THIS series of articles have been specially written to meet the requirements of the syllabus for the South Kensington Science and Art Examinations, and we feel confident that by placing a subject in a compact and yet efficient form, we shall fill a long felt want among mining students generally.

We must first understand how minerals are deposited.

They occur in various forms known as veins, strings, pockets, carbonas, flats, stockworks, &c. Each will now be described separately.

Veins are fissures in the earth that have been filled in with mineral matter. These fissures have been caused by one of these two ways, either by shrinking of the rocks through loss of heat, or by external pressure, and extend in some cases several miles in length.

When these fissures in the earth are filled with ore they are termed, "Shoots of Ore." Often they are merely filled with quartz.

If these veins are wide, and are rich in mineral matter they are called, "Gash Veins," and occur in the form of gashes.

Pipe Veins are found between the stratified rocks, and occur principally in limestone; they are more or less round, and in the form of pipes.

Flats are layers of mineral matter running between the stratification of the rocks.

Carbonas consist of irregular masses of mineral matter having no particular direction.

Stockworks are thin streaks of mineral matter permeating the whole of a mass of rock.

Pockets are masses of mineral matter occuring as pockets.

Here is an elementary list of where a few of the different minerals are found and in which formation—

Metals.	Place where found.	Formation.
Copper	America	Post-Tertiary
Copper	Urul-Russia	Permian
Copper	Cornwall & Wexford	Devonian
Copper	Norway	Laurentian
Iron	Sussex	Cretaceous
Iron	Cleveland	Ooliic & Liassic
Iron	Cornwall & Devon	Devonian
Stream Tin	Cornwall	Post-Tertiary
Tin Lodes	,,	Devonian
Lead	Derbyshire	Carboniferous
Lead	Cumberland	,,
Lead	Devonshire	Devonian
Lead	Cornwall	,,

Lodes as a rule do not run perpendicularly into the earth, but have a dip of about 70° or underlie as it is called. The width of Tin and Copper Lodes averages about 3ft. 6in.

We will now see the best methods to pursue in trying to find where the minerals are supposed to be.

(To be continued).

Water should not have a greater velocity than 200 feet per minute in pipes.

WINDING.

THE extensive winding operations now in use greatly contrast with the old methods of days gone by, and it is very interesting to search back to the earliest days of winding, when the men carried the material gotten on their backs up the shaft by means of notches cut in the side, or by ladders.

The next step in advance of this was the use of the Jack-Roll in its simplest form, which consisted of two beams laid parallel across the top of the shaft, fastened to which were two uprights, with a small roller and two handles.

The rope used at this time was an ordinary hemp rope, which was found to be amply strong enough for the shallow depths at which the shafts were sunk.

Another improvement was needed now that they had gone down a little lower, and the combined strength of two men winding was found insufficient to cope with the weight, and consequently they had to be displaced for an improved sort of Jack-Roll, worked by a horse, which is still used in some metal mining districts, and is called the "DERRICK OR WHIPSEY DERRICK," the cost of which was not much more, and a considerable amount more could be got out than by any other previous means.

The construction of this arrangement is as follows:—A pulley is fixed on four uprights over the pit shaft. Another pulley is also fastened in the ground, about 20 yards from the pit. The hemp rope is then run over the pulley that overhangs the shaft and under the other.

A horse is attached to the end, and is driven forward until it has pulled the stuff up the shaft, and gently backed to let the empty bucket down again. But this method was also found slow and inefficient to the wants of the mine, and could only be used in very shallow mines.

(To be continued.)

SINKING.

THE position of the shafts has in many cases in colliery management caused a great deal of loss and trouble that would not otherwise have occurred had the shafts been sunk in another part.

Therefore a great many things must be taken into account before the position is decided upon, such as

1st—If it is near a railway, canal, or some means where the coal can be taken away without incurring a large amount of extra cost.

2nd—Is labour cheap, and also if there is plenty.

3rd—It should be found by boring, or some other means where the deepest part of the seam is, and sink as much on the deep as is convenient to the surroundings, etc.

After the position of the shaft has been decided upon, the

Form of the Shaft"

is, perhaps, the next matter for consideration.

The form that is now most generally used being the circular for coal mining, and oblong for metal mining.

The two other shapes that have been used are the elliptical and polygonic, the latter being used in Belgium, where the deepest shaft in the world is sunk.

The circular is the most common in England, and it is certainly the strongest.

The oblong shaft used in Scotland for coal mines has the advantage of being easier to timber, and also economising the most of its room, therefore needing a less area for the shaft than would be needed in a circular one. But it has the great disadvantage of being the weakest form used.

The size of the shaft is the next thing to be considered and can only be accurately arrived at when we know what amount of coal is to be wound, and whether pumping is to be done in the shaft. The position, form, size, and other preliminaries having been dealt with we will now settle how the sinking is to be done either by contract for the whole depth or paying a chargeman and sinkers so much per day, which in this district, averages 6s. per shift for sinkers, and 6s. 6d. per shift for chargemen

(To be continued.)

VENTILATION.

COMPARATIVELY pure air is absolutly necessary for the support of life and combustion.

The air we breathe comprises oxygen, nitrogen, carbonic acid and water vapour. But carbonic acid being only a half per cent., and water vapour a little over one per cent. of the whole atmosphere, they need not be taken into account. The proportion of oxygen to nitrogen is as one is to four.

It is upon the oxygen that we really depend for life, while the nitrogen simply serves to dilute it. The oxygen mixes with the carbon of the blood, and we exhale a compound known as carbonic acid or carbonic anhydride, and four per cent. of this gas in the air is fatal to life.

That a current of pure air should be made to circulate through the workings of a mine is apparent from the following :—The men and ponies impart to the air a quantity of carbonic acid at each breath.

The combustion of candles or lamps causes carbonic acid to be given off.

If explosives are used they form smoke and gases.

Gases exude from the roof, floor, old wastes, and the coal of the mine.

Ventilation may be produced by either natural or artificial means.

NATURAL VENTILATION.

In some cases the position of the shafts renders it possible to take advantage of natural ventilation. For example, if the shafts be on sloping ground or one of the shafts be on the side of a mountain and the other at the bottom, in such a manner that when sunk to the level of the mine, one shaft would be deeper than the other ; then natural ventilation will be produced.

(To be continued.)

To cleanse pit stables use a disinfectant composed of permanganate of potash 1oz., water 2 gallons.

Working strain of a rope should be about one-tenth of breaking strain.

ELECTRICITY RELATING TO MINING.

UNDER the above head electricity will be dealt with as far as mining is concerned and in such a manner that if any student wishes, he can by the instructions given make his own apparatus and so increase his interest in one of the most interesting subjects connected with mining.

Electricity is used chiefly in mines for lighting and signalling, and it is these two that will be described.

Signalling being the simplest, will be explained first, it can be used both for shafts and for haulage roads and consists mainly of three parts—

1st—The Battery.
2nd—The Bell.
3rd—The Connections.

The battery that will be found to be the most suitable is the Le Clanche, in fact this battery is the best all round battery for any kind of bells or signalling, although a new kind called Dry Batteries are coming into use and are found to be very efficient.

The chief advantages of the Le Clanche batteries are—

1st—Simplicity in charging.

2nd—Small amount of attention to keep them in working order.

3rd—Their life is very long, often lasting two years without renewing the zinc or porous pot.

To students who wish to make their own batteries a short description here of

"How to make a Le Clanche Battery"

may be appreciated.

The following articles will be required : — Glass jar (preferably square), 7in. high and 6in. square; a porous pot (this must be round), 7in. high and 2in. diameter; a plate of carbon (with a terminal attached) 7in. high, 1in. broad, ¼in. thick. Some oxide of manganese and crushed carbon (the student will have plenty of the latter if *he* attempts to put a terminal in the carbon plate, unless he is unusually successful); a zinc rod, 7in. long and ¼in. diameter, and about 2ozs. of crushed sal ammoniac. These can be bought at any electrical works.

The battery costs about 2s. per cell to make, and it is made as follows :—You commence by taking the carbon rod, and putting it in the centre of the porous pot, then mix equal proportion of the oxide of manganese and crushed carbon, and fill round the carbon rod to within about an inch from the top of the porous pot.

(To be continued).

ANSWERS & QUERIES BY READERS.

IN this column we hope our readers will avail themselves of the opportunity of asking any queries.

Nom-de-plumes may be used, but their name and address must be sent.

REWARDS FOR MERIT.

We intend to give a number of questions that have been asked at examinations for managers, under-managers, and the Science and Art Examinations, for which we shall give a reward of 1s. for each best original answer.

PRIZE ESSAY.

We offer a prize of 10s. for the best original essay on "Pumps and Pumping," not to exceed 800 words in length, and also a consolation prize of "Mining," sent post free for six months.

Subject to the following conditions, which must also be observed in the answers to questions :—

1st—To be written on one side of the paper only.

2nd—The name and postal address must be attached to every answer or essay.

3rd—They must reach us by December 12th.

Question 1—Describe the operation of getting coal where explosives are not allowed?

Question 2—What is anthracite coal, what are its chief characteristics, and how does it differ from the other kinds?

Question 3—What is the negative load of a winding engine, and how is it counteracted?

Question 4—How are bits or borers tempered and sharpened for boring by hand?

Question 5—Describe accurately the way you would get water out of a shaft without using pumps?

Question 6—Describe the main and tail rope system of haulage, and discuss its advantages and disadvantages?

Question 7—State the best methods of fastening tubs to the rope in the endless rope haulage?

Question 8—How would you deal with a gob-fire?

Question 9—If an anemometer registers 2000 in a minute in a semicircular archway, the distance from the crown to the floor being 10 feet, and width 12 feet. What quantity of air is passing through this airway per minute?

Question 10—Where are the silver producing districts of the world, and what percentage of silver is found per ton?

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PRIZES FOR EVERYONE.

A NEW DEPARTURE.

For particulars see **No. 2.**

MINING DUST.

The inferiority of French miners to English colliers is shown by the fact that the average output of the miners in the district of Pas-de-Calais is only 150 tons per annum, while Durham colliers have an average of 333 tons per annum. The cost of coal in France is about 9s. per ton at the pit.

The word "Cash" comes from Chinese. It is the name of a small brass coin the Chinese use, with a square hole in the middle.

Smoking is so common in Japan that all men and ladies smoke, girls commencing at ten years of age.

Cramp in the Leg.—To cure quickly—draw a strong cord round the calves of the leg at once, pull it as tight as it can be borne, and the cramp ceases at once.

Procure a few pounds of copperas—dissolve in a bucket of water—and throw over places emitting bad smells, it will remove them.

To kill cockroaches, woodlice, fleas, and all insects,—dissolve allum in hot water and throw into their haunts.

To find the pressure per square inch due to a column of water, multiply the height in fathoms by 2·6.

To find the weight of steel ropes, multiply the square of the girth in inches by ·9, this gives the answer in pounds per fathom.

To find the H.P. necessary for ventilation, the following rule should be used—

$$\text{H.P.} = \frac{\text{Quantity of air in cubic feet per min.} \times \text{pressure}}{33{,}000.}$$

To find the weight of a cubic yard of iron pyrites (Sp. Gr. 4·2), the rule is—

$$\frac{\text{Sp. Gr.} \times 62{\cdot}5}{27} = \text{Weight.}$$

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TO OUR READERS.

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We therefore trust that our readers will further the interests of this Journal by introducing it to their Mining friends—for if it is once read it will be taken in regularly.

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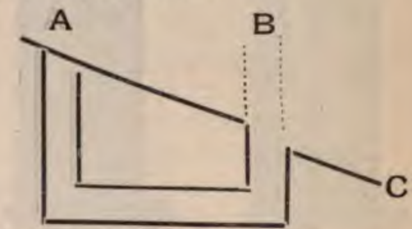
VENTILATION.

CHAPTER II.

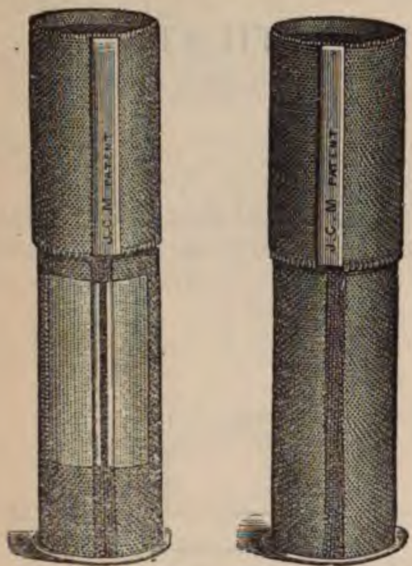
CONTINUING our description of Natural Ventilation, we must understand that it is produced to a certain extent in all mines. The following will give some idea of how it is caused :—



The above sketch represents two shafts sunk on a hillside, we can easily understand that the air in the shaft A will be warmer than that in B in the winter, owing to the heated strata, consequently it rises in A and ventilation is the result. The opposite to this takes place in summer and the air is reversed. The great disadvantage of relying on natural ventilation is—that sometimes the two columns of air just balance and the air is at a standstill. At the Seaham Colliery, with two shafts 520 yards deep, the airway 3,036 yards long, pit 14ft. diameter, the temperature at the bottom of the downcast is 49° F, at the bottom of the upcast is 52½° F, difference 3½° F, has produced natural ventilation to the extent of 7,000 cubic feet per minute. Another good

instance where natural ventilation to a very great extent is produced is at the Tyne Main Colliery. Depth of shafts 520 yards, and gave 36,000 cubic feet per minute.

We will now describe the use and improvements connected with the Safety Lamp Gauze—



The principle of the gauze is to conduct away the heat from the heated gases on their passage through the gauze, the flame is thus considerably cooled below ignition point before it reaches the other side. The gauze has 28 aperatures per lineal inch, and 28 squared means 784 per square inch. In the old style of gauzes it was and is the custom to stitch or bend together the two ends, this method is far from safe, as it is an easy matter for the wire of the gauze to become displaced or even the ends separate entirely. The above two illustrations of a new patent metallic seam gauze, manufactured by Messrs. Johnson, Clapham and Morris, Manchester, are about the best *arrangement we have seen.*

GEOLOGY.—By "Retso."

THE changes that are constantly going on at the present time in the earth are numerous, and perhaps the first and greatest agency is water in one or other of its three forms. Commencing with ice, we must notice what a great influence glaciers have whereever they are met. Glaciers are tremendous accumulations of ice and as a rule are found moving slowly down valleys, transporting large quantities of material with them. The stuff that they carry is known as "Moraine Stuff." If it is each side of the glacier it is termed "Laternal Moraines." When two glaciers come together the two outside Laternal Moraines that form now the middle are called "Medial Moraines." Moving slowly on, sometimes for years in this way, the glaciers at last come to a warmer latitude where they gradually begin to melt, leaving a mass of stuff that has been collected on its way in a heap, this is known as "Terminal Moraines." The great peculiarity of glaciers, is the scratching and wearing away of the rocks over which they pass. There are many records of glaciers in England and Wales, at one time known as "The Ice age." Glaciers were as far down in England as the river Thames, they have since gradually receded back to the northern hemispheres. Thus we see one of the largest transformers in connection with the ever changing earth. When water has soaked into any porous rocks as "Sandstone," and begins to freeze, it then expands, thus producing an internal pressure between the particles of the rock and the cohesion of the ice until the ice commences to melt, when the rock will crumble to pieces and is carried away by means of rivers, etc.

ELECTRICITY RELATING TO MINING.

CHAPTER II.

SOME pitch must now be got and be made very hot, after it is in a thick liquid state, it should be poured on the crushed carbon and manganese to the top of the porous pot; care must be taken to leave a small hole through the pitch for the gas, etc., to escape, the best way to do this is to have a thin piece of glass tubing $\frac{1}{16}''$ diameter, or an $\frac{1}{8}''$ would do, and hold it so as to pour the pitch round it; care must be taken to have the carbon rod projecting about 1″ above the pitch, as in the following illustration of a completed Le Clanche Battery.

The porous pot being now complete, it is put in the glass jar and also the zinc rod. The glass jar must now be filled to within an 1″ off the top with the following solution :—

Sal Ammoniac........ 2 ozs.
Water .... 1 pint.

If the battery is larger than the above quantity it must be filled up and more solution made. The battery must now stand for 24 hours before it is in working order.

In our next article we shall deal with the Electric Bell.

(*To be continued*).

Detmold invented the Blast Furnace in 1842.

The working strain of timber should not be more than a quarter of breaking strain.

SURVEYING.

This article has been left over until our next number, through the blocks not being to hand at the time of going to press.

STEAM AND THE STEAM ENGINE.

CHAPTER II.

STEAM possesses other qualities besides being invisible and elastic, the ones that will be described in this chapter will be upon the Sensible and Latent of steam. Sensible heat is the amount of heat contained in a substance that is sensible to the thermometer. Latent heat is the amount of heat contained in a body, and that is *not* sensible but latent to the thermometer. An experiment will now be described to prove the latent heat of water, this was first discovered by Professer Black. He placed a lump of ice in an equal weight of water at 176° F, and found that when the ice had just melted the temperature of the water was 33° F, and by substracting 176° F—33° F=143, as the amount of heat required to melt ice, thus ice must have 143 units of heat in it, consequently it is called the Latent Heat of Water. Professor Black's experiment to prove "The Latent Heat of Steam," consisted of putting a dish on the fire, in which was put some water at 50° F, and he saw that in 4 minutes the water began to boil, and in 20 minutes it had all evaporated. Now, as the water reached boiling point 212° F
from 50° F

minutes, he reasoned that it had been receiving this for 4 minutes × 5=20 minutes, and therefore × 162 by 5=810, as the Latent Heat of Steam. More correct experiments make it as 966.

(*To be continued*).

METHODS OF WORKING COAL.

LONGWALL.

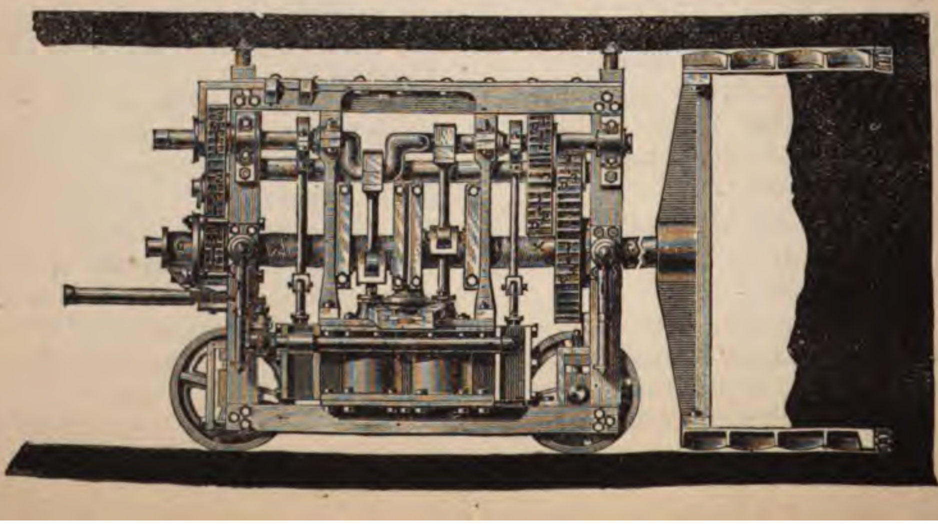
Chapter II.

AFTER it has been decided which method the seam is to be worked, arrangements have to be made about the labour. There are various ways that miners are paid, for example:—three men have charge of a stall, they are paid so much a ton for the large coal filled, and so much a ton for the small coal filled. In other cases the small coal has to be thrown back and only the round filled, but this is a very bad plan, because, whenever coal is stacked it is always liable to spontaneous combustion, and when once a fire commences in a mine it means a great deal of cost and inconvenience to put it out. In some districts the men are paid so much per ton for all coal got, and so much per score of tubs filled. A few of the prices, etc., in various districts will be given in another article. Allowance is generally given for the timber that is set as so much per chock, bar or prop, etc., the miner may build or put up. One hewer is usually paid, he again paying the fillers or drawers. No fixed rate or method of payment can be made, the circumstances and methods of paying, varying widely in different districts. The next and perhaps one of the most important considerations is, what amount of coal must be left to "Support the Shaft?" This cannot be decided until many things have been taken into account, and we may mention:

1st—Nature of the coal.

2nd—Condition and nature of roof and floor.

On no occasion is it safe to leave less than 50 yards square of coal for any depth of a shaft down to 150 yards. Under ordinary circumstances it may be taken that if 5 yards square is left for every 20 yards the shaft goes down below 150 yards, it will be found sufficient. So that if a shaft is say 200 yards down, we leave 50 yards square for 150 yards deep, so that we should safely leave 65 yards square of coal for a shaft 200 yards deep.



The preceding illustration represents a new and very successful form of "Coal Heading Machine." Owing to the pressure for space in this number, we have been obliged to hold the description over.

CHEMISTRY IN MINING.

Chapter II.

HAVING thoroughly mastered the few technical terms, that it is absolutely necessary for us to understand, we must now know a little concerning the "Density of Gases." The way to find the density of any compound gas is very simple, and we will take say $C\ O_2$ or Carbonic Anhydride, its composition we see is 1 atom of carbon, 2 atoms of oxygen.

Referring back to the list given in the last number we know that the weight of

1 atom of C=1 × 12 (atomic weight)=12
2 atoms of O=2 × 16 (atomic weight)=32

44

Therefore, as there are two atoms in every molecule of $C\ O_2$ we must divide the 44 by 2, this=22. The density of $C\ O_2$ then is 22. After this has been impressed upon the reader's mind, we will see how to find the density of a "Mechanical Mixture." One of the best mechanical mixtures that we can take is air. The approximate chemical formulae for air is $4\ N_2 \times O_2$ That is 8 atoms of N × 2 atoms of O. And as 8 atoms of N weigh

8 × 14 (atomic weight)=112
2 atoms of oxygen weigh 2 × 16= 32

144

Divided by the 10 atoms=14·47, this being the density of air. We will now just know a little about the Specific Gravities of Gases, put (Sp. Gr.) for short. The rule that must be adopted to find the Sp. Gr. of any gas is

$$\text{Specific Gravity} = \frac{\text{Density of Gas.}}{\text{Density of Air (14·47)}}$$

Thus you divide the density of air into the density of the gas, and the result is Sp. Gr. of that gas. Appended are three examples—

$$\text{Sp. Gr. of } C\,O_2 = \frac{22}{14{\cdot}47} = 1{\cdot}528 \text{ Sp. Gr.}$$

$$\text{Sp. Gr. of } C\,H_4 = \frac{8}{14{\cdot}47} = {\cdot}55$$

$$\text{Sp. Gr. of } H_2S = \frac{17}{14{\cdot}47} = 1{\cdot}18$$

In our next chapters, the various gases will be dealt with, their peculiarities, how made, and experiments connected with each will be thoroughly explained.

It is not our aim to weary the student with too much matter on this subject in each number, but sufficient will be found to be well mastered.

(To be continued).

METAL MINING.

Chapter II.

IN searching for minerals you must be guided either—

1st—By the general confirmation of the country.

2nd—By looking at the sides of hills and elevations for any signs of metallic matter, or by observing mole hills, etc.

3rd—"Shodes" form a good observation, and consist of stones of ore; when shode stones are found you must follow them up (they are generally found on hill sides) until they disappear, where you may expect to find the top of a lode.

4th—"Gossan" (this is the upper decomposed part of a lode, and consists of Cellular Quartz and Oxide of Iron Fe. O. practically a fault). If gossan in large quantities is found it is usually a good sign for Copper, Lead or Iron lodes in near proximity.

5th—"Springs" of water. The character of the lode can be ascertained by the colour of the water.

Red water indicates Iron.
Green stained water, Copper.
If Blue, Lead may be expected.

Lodes have been accidently found in several remarkable ways.

During the operation of making a Railway Cutting, a very profitable lode was exposed.

In Quarrying also lodes have been met with.

Another and the most general way of finding a lode is by the method known as "Costeaning," by which pits are sunk down, say—20 or 40 yards apart and levels driven from one to the other, so that if a lode runs between two shafts it cannot fail to be discovered.

After the lode has been found the next operation is to sink the shaft, which is not always sunk perpendicularly into the earth but is sunk so as to follow the underlie of the lode, but it has been more common of late years to sink a vertical shaft and have the levels driven to the lode. The size of the shaft is usually 10′ × 8′ although sometimes larger.

(To be continued).

SINKING.

Chapter II.

BEFORE we can actually describe the operation of sinking we must know what tools are used, and how they are tempered. All the tools used during the operations of sinking require to be of the very best quality, to have them inferior means inferior work.

Shovel.—This well-known tool is used to remove the loose debris at the bottom of the shaft, and consists in the upper part of an iron socket, to receive a handle of good strong Ashwood, the handle is usually about 30″ long, and is at the top like a  The plate or bottom part of the shovel is of iron, length about 15″ and breadth at top from 10″ to 16″, and weighs about 7lbs.

Clay Shovel is used to remove the heavier earthy matter in the commencement and for clay, it is a rather long and narrow spade. The plate being square, about 12″ long and 8″ broad.

Pick.—This is without doubt the chief tool of the miner, it consists of an iron head, having two arms and a hole in centre for the shaft or helve, the ends of the head are steel tipped and are either pointed or chiselled—the chisel shape being used to dress the sides of the shaft, etc. The pick heads are either straight or curved, and may be classed under three heads:

1st—Metal Picks.
2nd—Cutting Picks.
3rd—Holing Picks.

Metal picks are of a much heavier make than the other two, being used chiefly in sinking, tunnelling, etc. Cutting picks are slightly heavier than holing picks, being used to cut the sides of a heading, etc. Holing picks are of course used to hole or kirve the coal for blowing or wedging. The shapes, sizes and weights, vary so very widely in different parts of the country, we shall only describe and illustrate a few in our next article, after which we will describe the method of tempering.

HAULAGE.

Chapter II.

IMPROVEMENTS constantly were being made, until we get to the types of Haulage and Hauling arrangements in use to day, which will form the chief subject of these articles. At the present time nearly all rails used in the mine are what are called the "Bridge pattern."

The above sketch being the end view of a rail. They are made in various lengths, generally however in two and four yard lengths. These are however gradually giving way to the type known as the "Flange Pattern." Where the roadways have to become permanent and the haulage carried on as smoothly as possible, and without being constantly stopped, the use of this type of rail is gradually coming to the front.

The average weight is about 30lbs. to the yard of this rail. The rails are laid about 24″ apart, this being a good useful guage, although sometimes they are 18″. The chief objection to a narrow guage of rails is that the tubs frequently become overturned. Rails are generally laid upon sleepers varying in size; for bridge rails a good useful size is—

Length 30″
Breadth 8″
Thickness 2″

This will be found plenty strong enough for all ordinary purposes, and they should be cut out of good strong larch. Steel Sleepers are coming now into more common use. Bagnall's steel sleepers are a little wider than the ordinary wooden ones, there being four jaws or chairs on each sleeper to hold the rail. The sides and ends are turned down, thus preventing displacement, especially in curved roads. In Hipkin's sleepers they are turned down all round, the top is flat, and they have only two jaws. They weigh about 10lbs. each.

(To be continued).

WINDING.

Chapter II.

THE next improvement of any note was the "Horse Whim." This was a very powerful (in those days) and efficient mode of getting the stuff up the shaft and for winding water. The construction of the part directly over the shaft was similar to the "Derrick"; at a distance of some yards was an arrangement of beams to support a barrel, a bar was connected to the barrel and horses were used to turn it round, thus winding the rope round it. The cost of this Whim was about £20.

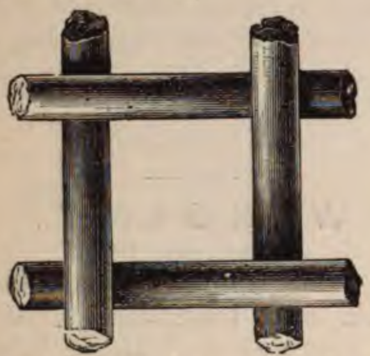
We will leave the primitive methods of winding, and in our next article give a description and illustration of the latest form of Iron Pit Head Gear.

COLLIERY APPLIANCES.

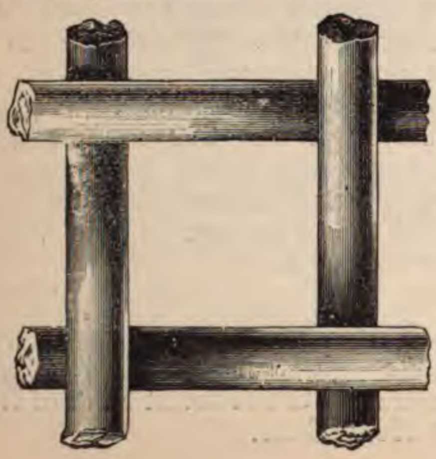
SCREENS.

THE following illustrations are of an extra strong make of steel screeners :—

The above is an $\frac{1}{2}''$ mesh, made of No. 6 guage of wire and costs about 1/2 per square foot.



This is a size larger, having a $\frac{3}{4}''$ mesh, the wires are all of steel and No. 4 guage; this size costs about 1/2 per square foot.



This is the largest size that w have sketches for, it is a 1″ mesl and the wire is $\frac{5}{16}''$ thick. Th disadvantage of having the steel bai is its liability to rust, this can howeve be overcome by having ther galvanised. The above are manu factured by Messrs. Johnson Clapham and Morris.

In our next number we will desrib and illustrate another patttern o screens.

MINING FORMULÆ.

TO find the weight of a giver volume of any gas at a known pressure and temperature, the following formulæ will be found simple and efficient, let :—

W=Weight in lbs.
V=Volume in cubic feet.
B=Barometer in inches.
T=Temperature in degrees F.

$$W=\frac{1{\cdot}3253 \times B}{459 + T} \times V.$$

To make this a little more clear, suppose a quantity of say 500 cubic feet of air at a temperature of 50° F, and the pressure as registered by the Barometer is 30 inches. Putting it in the form of the rule, it reads—

$$W=\frac{1{\cdot}3253 \times 30}{459 + 50} \times 500$$

which is—

$$W=\frac{39{\cdot}7590}{509} \times 500$$

This equals ·07811lbs. per cubic foot and this × 500 is 39·055lbs.

To find the strength of Ropes when :—

W=Breaking load in tons.
C=Circumference of Rope in inches.

ıle for:—
np Ropes is $W=\cdot25\ C^2$
ı Ropes is $W=1\cdot5\ C^2$
ıgh Steel Ropes is $W=4\ C^2$

ɔse a Hemp Rope is 8″ in rence, what is the breaking ons? Rule:—

$$W=\cdot25\ 8^2$$

$8^2=8\times8=64\times\cdot25=16$ tons, coning $\frac{1}{10}$th as a good working we may say that $1\frac{1}{2}$ tons is good working weight. If we [ron Rope of the same size, find by the rule that—

$$W=1\cdot5\ 8^2$$

$3^2=64\times1\cdot5=96$ tons as ; weight and taking $\frac{1}{10}$th ns as safe working load.

g the same size for a Plough ɔpe we find that—

$$W=4\ 8^2$$

$^2=64\times4=256$ tons breaking and taking $\frac{1}{10}$th it equals $\frac{1}{2}$ tons as a safe working load.

❖ ❖ ❖

alculate strength of Boiler use the following simple en:—
ɔllapsing pressure in lbs. per square inch.
Thickness of plate in inches.
iameter of tube in inches.
ength of tube in feet.
e is—

$$P=\frac{806000\ TH^2}{L\ D}$$

ɔse a Boiler Tube is, for :, say—
$\frac{1}{4}$″ thick.
diameter being 2″
length of tube 10′
lapsing pressure in lbs. per nch is—

$$P=\frac{806000\times\frac{1}{4}^2}{10'\times24}$$

gives us $\frac{100750}{240}$ or 420 lbs. ıre inch pressure.

ANSWERS TO CORRESPONDENTS.

H.G. (Darlington).—1—Yes. 2—Divide by 33,000. 3—Glad you like our paper.

Kilpie.—We have made a note of your suggestion, and will give it our earliest consideration.

A.D.F. (Glasgow).—Thanks for the letter, glad our paper interests you so much.

Miner.—We shall commence a series of articles on the subject you name, in the course of a few weeks.

Student.—1—By all means. 2—Yes. We certainly recommend you to take a course of lessons of T. A. Southern, Derby.

J.J.K.—We are always open to news that will both interest and instruct. We will pay you according to its merit. Send it along, and do not forget stamped addressed envelope, in case of rejection.

Under-Manager.—You will get what you want from any electrical firm. Glad you have enjoyed No. 1.

W.T.G. (Wigan).—I do not know exactly, about 1830, as near as I can find. 2—Several new improvements will be started shortly. See our notice elsewhere.

M.A.C. (Leeds).—The rule reads $p=\frac{K.\ S.\ V^2}{A}$ You might get what you want through our advertising column.

Americus (Newcastle).—1—The article you name is quite correct. 2—We have never heard of any such method, it may be correct, it sounds sensible, try an experiment and let us know the result.

QUERIES BY READERS.

Dear Sir,—I should feel much obliged if you will insert the following:—What is the best method to find what H.P. of a Hauling Engine I shall require to pull 15 tubs of coal up an incline of 1 in 8—800 yards long. The tubs weigh full 11 cwt., and also what sort of Hauling Engines would you advise me to have?

Yours truly,

G—— S——.

Pendlebury.

Dear Sir,—By inserting the following in the "Queries by Readers" column I should feel greatly obliged.

Yours truly,

M—— T——.

"Will any reader please give me the rule to find the contents of a stack of Cannel, it is both small and round; and also will water increase the specific gravity of Cannel by its standing stacked."

Dear Sir,—Will you please let me know how to find the size of a pair of pumping engines to pump 1000 gallons per minute from a depth of 150 yards?

Yours truly,

R—— T——.

St. Helens

Dear Sir,—Will you please insert this in your next issue:—I am greatly troubled with Iron Pyrites, in what would otherwise be a good seam of coal. How would you deal with them? A reply from any reader would be esteemed.

Yours sincerely,

"Troubled."

Nottingham.

REWARDS FOR MERIT.

We intend to give a number of Questions that have been asked at Examinations for Managers, Under-Managers, and the Science and Art Examination, for which we shall give a uniform reward of 1/- for each best original answer, subject to the following conditions, which must be observed in all competitions:—

1st—To be written on one side of the paper only.

2nd—The name and postal address must be attached to every answer or other competition.

3rd—They must reach us by December 27th.

4th—Write "Merit" in left hand corner of envelope.

We offer a prize of 2/6 for the best short tale, either humorous or adventure, connected with Mining, and not to exceed 200 words in length; and also a consolation prize of "Mining," sent post free for six months.

On page 23, column 2, of this number, we have purposely left out a word. To the sender of the first letter opened on Tuesday, December 27th, containing the correct word, we shall send "Mining" post free for six months. Write "Competition" on the left hand corner of envelope. A coupon will be found on the cover which must be sent in with every attempt.

We shall send "Mining" post free for six months, for the four best Mining Jokes that have not appeared in print before.

Question 1—Give an account of working a thick coal with a bad roof?

Question 2—At what rate will it be necessary to work a 12″ pump, stroke 9′, to keep down a flow of 200 gallons of water per minute, in a shaft 200 yards deep. What will be the H.P. required?

Question 3—Give an outline of the methods of separating lead and blende ores from sparry vein stuff?

Question 4—What are the best methods of preserving the timber used underground?

Question 5—Where and how can Iron be used instead of Timber underground?

Question 6—Give a clear outline of the plant and machinery required for working rock drills at a considerable distance from the shaft?

Question 7—Give an account of the principal lead mining districts in Europe?

Question 8—When the water gauge read 2·4 there were 150,000 cubic feet of air passing per minute. What was the H.P. of the furnace?

Question 9—In a colliery the quantity of air circulating was 70,000 cubic feet per minute, the water guage was 1·5 inches. What is the H.P. in the air? If the ventilation was increased to 100,000 cubic feet per minute, other circumstances remaining the same, what will the water gauge be?

Question 10—How would you work a seam of coal 30ft. in thickness?

MINING DUST.

2,000 Men and Boys have received notice of a reduction of 7½ % in the Forest of Dean Coalfield.

❖ ❖ ❖

The trade at present is very slack in Gas Coal.

❖ ❖ ❖

The representatives of the Durham Colliers have agreed to the reduction of 6½ %

❖ ❖ ❖

———— is being manufactured as an experiment for Helmets for the Police. It has the advantage of being very light. (See Prizes.)

❖ ❖ ❖

If the seas of the world were to all evaporate there would be a solid deposit of salt 45 feet thick.

❖ ❖ ❖

The Examiners at the Manchester Examination for Certificates for Managers and Under-managers on December 22nd and 23rd, are—

Mr. R. Winstanley, Pendleton.

Mr. D. Arthur, Accrington.

Mr. Tongue, Bolton.

❖ ❖ ❖

The British Government ordered 20,000 Telephones for use in the Postal Service in 1880.

❖ ❖ ❖

The atmosphere is so clear in Zululand, that objects can be seen by starlight at a distance of 5 miles.

❖ ❖ ❖

The Austrians consume on an average 273lbs. of Tobacco or about 2¾lbs. per person per annum.

The Diamond is the purest form of Carbon known.

❖ ❖ ❖

It was a man named Outram that invented Pit Rails.

❖ ❖

The resistance of Bricks to crushing is about 3,000lbs. per square inch.

❖ ❖ ❖

Four per cent. of Carbonic Anhydride is fatal to life, it is always found first near the floor of a mine.

❖ ❖ ❖

Smeaton built a 72″ Cylinder Engine as far back as the year 1764.

❖ ❖ ❖

James Watt used packing for pistons in 1768.

❖ ❖ ❖

The greatest strain on a rope should not be more than 700 times its weight per fathom.

❖ ❖ ❖

A Natural Ink: In Algeria there is a river of ink, the stream is water until the meeting of two of its tributaries. One of these flows through soil rich in iron, the other through a peat bog. When these two unite, the chemical action of the iron on the gallic acid of the peat makes a beautiful writing fluid. A trip to Algeria will prove this.

❖ ❖ ❖

Mr. Justice Kennedy, the new Judge, speaks eight languages fluently.

❖ ❖ ❖

Borax has been found for centuries in a lake in Thibet.

Advertisements.

SALE, EXCHANGE,

AND

SITUATIONS WANTED.

FOR the first 20 words, or less, 6d.
For every additional 3 words, 1d.

REDUCTIONS :—

3 insertions,	1d. in the shilling.		
6	do.	2d.	do.
13	do.	3d.	do.

DEPOSIT SYSTEM.

To help transactions between strangers, the purchase money may be deposited with us. We will acknowledge the receipt of the money to both parties, and hold the deposit until we are satisfied that the goods are returned, or the purchase satisfactorily concluded. For which we shall deduct one shilling for expenses.

We cannot undertake to receive any articles, therefore money to the estimated value must be sent, addressed—

SALE AND EXCHANGE,
Editor of "MINING,"
Messrs. STROWGER & SON,
Publishers,
WIGAN.

Printed and Published for the Proprietors by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

MINING

A Journal devoted to the interests of Mining.

No. 3. Vol. I. DECEMBER 29TH, 1892. FORTNIGHTLY ONE PENNY.

MECHANICS RELATING TO MINING.

IT is absolutely necessary for Students studying for certificates to know something of mechanics, and in these articles I shall endeavour to give a brief knowledge of applied mechanics so far as it appertains to mining.

The most approved methods of raising, banking, and screening the coal, and also the most efficient systems of ventilating mines, with detailed remarks upon the various machinery connected with these, we will now understand what is the term *machine*. A machine is an arrangement of levers, wheels, shafts, etc., in the majority of cases for the purpose of concentrating force—or converting it into a condition from which we get the most work. It must now be clearly understood, that no more really can be got from a machine than is put in it. The state of things existing in a machine resembles the working of a lever. You can move a ton weight at one end of a bar by applying a force of 1cwt. at the other, but of course the *force* employed must be 20 times as far on one side of the fulcrum, as the weight is on the other—so it is with machinery. By an arrangement of levers, wheels, screws, etc., we seem to get big results, yet the resultant is actually less *than the* applied *power*.

We will now see and thoroughly understand the action and mode of working of the different fans. We will not enter a discussion here upon the advantages or disadvantages of fans over furnace ventilation, but suffice it by saying that in every case of colliery ventilation, the advantages of fans are much greater than their disadvantages as compared with furnace ventilation.

In my next article I shall give a detailed description with illustrations of the Guibal Fan.

SURVEYING.

By a "Surveyor."

CHAPTER II.

AFTER having grasped what is meant by magnetic variation, we will leave this part of our subject for the present. We find that the 34th Section of the Coal Mines' Regulation Act, stipulates that "The owner, agent, or manager of every mine, shall keep in the office of the mine, an accurate plan of the workings of the mine, showing the workings up to a date, not more than three months previously, and the general direction and rate of dip of the strata, together with a section of the strata sunk through." It is not only because we are compelled to have correct plans of a mine, but because it materially helps to work that mine with greater economy and

safety. The articles that are generally used in underground surveying are—chain, dial, legs, tape, note book, chalk, string, etc.

The chain that is generally used is called *Gunter's Chain*, it is 22 yards, 66 feet, or 4 poles in length, and is divided into 100 links, the length of each link is found as follows:—

$$\frac{66' \times 12''}{100} = 7{\cdot}92 \text{ inches.}$$

At the end of every 10 links is attached a brass counter (see illustration) to help to find the length more readily. For measuring the depth of a shaft it is done by having a great length of copper wire, wound on a roller, one end is lowered gently down the shaft to the required distance, then at the top of the shaft a piece of string is securely tied to the wire, it is then wound up and run out the same length in a field where it can be readily measured.

A

In our next article we shall give a description of the ordinary dial.

(*To be coutinued.*)

HAULAGE.

CHAPTER III.

BEFORE we commence an illustrated description of the various methods now adopted in hauling, it is best to consider some very important improvements that are now being introduced in connection with the latest haulage arrangements, and in this number we shall briefly describe the "Climax Grip Pulley" and its advantages over the ordinary kind now generally used.

The great disadvantage found in the ordinary pulley now used, is that the rope is found to slip, thus causing great loss of power.

In the above illustration it is seen that the groove is in a spiral form, this not only effectually prevents the rope from slipping, but is a great

saving in wear, this is certainly the best pulley now on the market for simplicity, cheapness, and non-liability to get out of order.

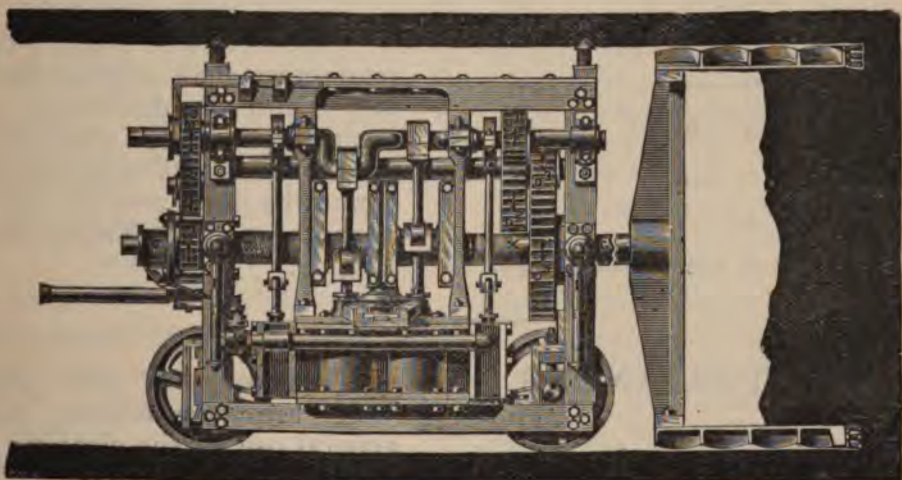
If we take a ¾" rope and lay it round the pulley with one end loose, the other end will support over one ton weight without slipping—this test should speak volumes in its favour.

It is becoming universally used, and wherever tried has given every satisfaction.

METHODS OF WORKING COAL.

CHAPTER III.

FOR the advantage of our readers who were not able to secure our last number owing to the tremendous demand, we have again inserted the block of Messrs. Stanley Bros. Patent Coal Heading Machine, which has been awarded the only Gold Medal. We shall give three illustrations of this very practical machine, first what is called the single machine, second the double, and thirdly the full cut machine, each of which will be thoroughly described in detail.



The above is the type of machine used for driving in pure coal, and when narrow roads are more especially required. The advantages of these machines are, first:—

Increased Speed, being about four times as fast as hand labour, it has done in fact in many trials over one yard per hour.

Cost.—A reduction in cost equal to 60 %

Greater proportion of Round Coal, being in many cases 75 %

Economy in Timber.—Owing to the circular groove cut the roof does not need proping.

Improved Ventilation.—Owing to compressed air being used it ventilates the headings.

Greater Safety in fiery mines, because owing to explosives *not* being used, it does not shatter the floor and roof thus producing falls.

In our next article we shall describe the action of this machine, and also the double one.

W I N D I N G.

Chapter III.

WE will now consider the method to adopt in answering any question, such as is given below :—

"What arrangements would you make to raise say, 100 tons per hour when the depth of the shaft is 300 yards ?" First—You would have a double horizontal engine direct acting, and in finding size, etc., we proceed as follows :—

100 tons per hour $= \frac{100}{60} = 1·6$ tons per minute or about $1\frac{2}{3}$ tons.

The time of winding being :—

$$\frac{300 \times 3}{1000} = \frac{9}{10} \text{ of a minute.}$$

Suppose we have a doubled decked cage capable of holding two tubs on each deck,

then $\frac{30}{4}$ cwt. $= 7\frac{1}{2}$ cwt. per tub.

$\therefore 1\frac{2}{3} \times \frac{9}{10} = 1\frac{1}{2}$ tons of coal in the cage.

The actual weight of full cage and coal—

	Tons.	Cwt.
Cage and Chains...	1 -	4
Coal in 4 tubs	1 -	10
4 empty tubs = 4 cwt. × 4		16
	3 -	10 + weight of rope.

The weight of 300 yards of iron rope at say, 7lbs. per yard= 2100lbs. or nearly 1 ton (2240lbs.) ÷ 3 ton 10 cwt. = 4½ tons for safe working load of rope.

The size of Winding Engine necessary :—

Size of drum 16′
Stroke 5′

Pressure of Steam 60lbs. per sq. in.

The piston speed being 400 feet per minute $\frac{400}{5 \times 2} = 40$ strokes per minute, then $40 \times 16'$ (size of drum) $\times 3·1416 =$ 2010 feet per minute=average speed of cage in the shaft, then $\frac{300 \times 3' \times 60 \text{ (minutes.)}}{2010} = 27$ seconds.

Therefore as the journey must be made every 54 seconds=54—27=27 seconds allowed for changing.

To find the size of the cylinders :—

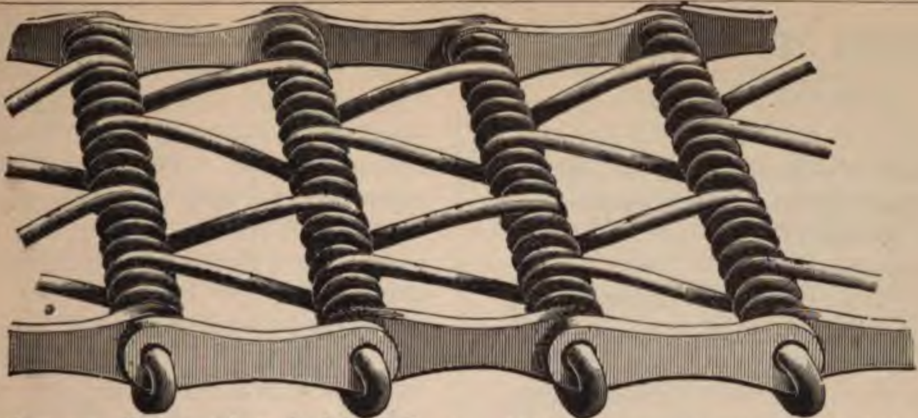
$$\frac{50·26 \times 2\frac{1}{4} \times 2240}{5 \times 2 \times 60} =$$

469·09 × 234·54 (for friction) = 703·63
and $\sqrt{\frac{703·63}{·7854}} = 30''$ size of cylinder.

While here and in reply to several readers we shall explain the advantages and disadvantages of using steam expansively. Why very great pressures (as 500lbs. per square inch) cannot be used, and also the use and advantages of the Triple Expansion Engine.

MINING APPLIANCES.

In this number we here give an illustration of an improved steel wire coal picking belt. The necessity of coal being sent away from the colliery absolutely free from dirt cannot be over estimated. Belts are now coming more into general use for the cleaning of coal, and the type given on next page is one that may be well recommended, and in our next we shall have an illustration of steel wire screens that have been greatly improved.



We give an illustration below of an improved torch lamp.

This has been brought out to supercede the old torches that flame away, smoking everywhere around them, it is not only more economical, safer, and cheaper—but has the great advantage of giving a steady and uniform light. They are made by Messrs. Johnson, Clapham, and Morris, Manchester.

QUERIES BY READERS.

Are Mining Inquests Properly Conducted?

A question of considerable interest to a mining community is whether Mining Inquests are properly conducted. In many instances the Jurymen selected are composed of the local grocer, haberdasher and butcher, and sundry other tradesmen, who cannot have the intimate knowledge with the working of a colliery that would appear necessary. When questions of liability and negligence are concerned the intricate details that are submitted at the Enquiries, often leave the Jury mere automatons in the hands of the Coroner and Mining Authorities. It would appear that this is a course that is within the possibility of reform and capable of many alterations that would render inquests more satisfactory to those concerned. By the more critical, it will be contended that we should require Jury Specialists for every accident; but this is not the case when we review the conditions under which the miner works, we are forced to an admission that none but those who have been in practical contact with his work can enter into the details of an accident that may befall him. Whilst advocating the reform it would not be desirable to exchange the present constituted Jury for a stereotyped crowd of Colliers who should appear at every inquest that is held. On the other hand it would be to the best interest of miners that they should demand that one of their craft should have a voice in the conduct of an Enquiry concerning the loss of life in the mine, in preference to men who are totally unacquainted with the affairs of life other than on *terra firma*.

WIGAN. R.D.R.

(Discussion is *invited* by our readers on this interesting subject.—Editor.)

ANSWERS TO QUESTIONS.

December 1st, 1892.

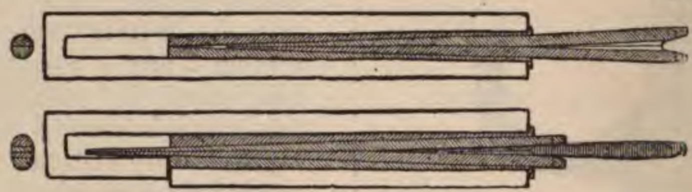
Question 1—Describe the operation of getting coal where explosives are not allowed?

Answer to Question 1.—

It is first holed or kirved to a depth of 3 feet or more and then cut on each side, steel wedges are driven in along the face and forced down, this is a very old method. In the Plug and Feather system a hole is bored and two pieces of steel rounded on one side are placed into the hole with their flat sides to each other and a steel wedge driven in between them.

By the Hydraulic Press a large hole is bored into the coal into which are placed a number of small presses and water forced into them by a force pump. The Coal Detacher consists of two angular pieces of steel, at the back and foreside of which is a nut, one left-handed and the other right-handed screw threaded; when a right-handed screw is turned in those nuts, the nuts will advance to each other, forcing down the coal. There is also the Roller Wedge, and other kinds of Mechanical Wedges.

JOHN GRAY,
Oliver's Buildings, Glebe Row,
Bedlington,
Northumberland.



Question 2—What is anthracite coal, what are its chief characteristics, and how does it differ from the other kinds?

Answer to Question 2.—

Anthracite is more compact and dense than ordinary coal; it has generally a shining and sometimes semi-metallic lustre, and does not soil the fingers. Anthracite burns without smoke or flame and gives out an intense heat. About 90 per cent. of this coal is carbon, and 3 per cent. hydrogen, the remaining 7 per cent. consisting of oxygen, nitrogen, and earthy substances. Specific Gravity 1·25 to 1·4. Ordinary coal contains less cerbon and more hydrogen than anthracite.

WILL: SUTHERLAND,
46, Stoney Lane,
Hindley,
near Wigan.

Question 3—What is the negative load of a winding engine, and how is it counteracted?

Answer to Question 3.—

The negative load in winding is the difference of load in favour of the descending load, and occurs when the weight of the rope is greater than the weight of coals which are being raised. Different methods are adopted for counterbalancing the weight of rope in winding.—(1) *The pendulum system:* This consists of a wooden beam about 50 feet long, suspended at the upper end by a hinge joint, having a load at the lever end in proportion to the weight of rope. If the cage was at bank the pendulum would be horizontal, being lifted by a drum fixed on the engine shaft, having a chain passing over a pulley. When the cages meet in the middle of the shaft, the whole

of the chain constituting the balance is off the roll, but after this the roll commences to wind on all the chain in the opposite direction and the pendulum assumes a horizontal position. Thus the weight is always in position to exert its greatest power when the ropes are most out of balance.—(2) *Balance chain and staple:* A barrel with a chain attached is fixed on the main shaft of the engine. A small shaft or staple is sunk exactly beneath the chain barrel. The number of coils of the chain on the barrel are equal to half the revolutions made by the engine in bringing the cage from the bottom to the bank, so that when the cages pass each other in the shaft the whole of the chain is uncoiled off the barrel it then commences to wind on all the chain in the opposite direction, thus causing the chain to be exerting its greatest weight when most required.—(3) *Conical and spiral drums:* These drums constitute a lever the length of which varies in such a manner so as to compensate for the varying weight of rope in the shaft.—(4) *Tailrope or Koepes balance:* This consists of a tail rope attached to the bottom of one cage passing down one side of the shaft and round a loaded pulley fixed in the bottom of the shaft, and up the other side, and attached to the bottom of other cage, thus causing an equal weight of rope in both sides of shaft.

FRANCIS HAILSTONES,
4, Windsor Street, Burnbank,
Hamilton,
Scotland.

Question 4—How are bits or borers tempered and sharpened for boring by hand?

Answer to Question 4—

Bits or borers are heated and hammered until they have a fine edge and the shape required, they are then passed through a gauge to see if it is the size wanted. It is put back into the fire to heat it to cherry red, and then put into water, oil or coal tar, and immediately withdrawn, a blue colour will be shown, and if cooled further it will become purple, by putting it into water, oil or tar again and kept in a little longer, it will become a straw colour, which indicates the proper hardness for boring.

JOHN GRAY,
Oliver's Buildings, Glebe Row,
Bedlington,
Northumberland.

Question 5—Describe accurately the way you would get water out of a shaft without using pumps?

Answer to Question 5—

The way I would raise water from the bottom of a mine without the use of pumps would be by a veil which would be self-acting as regards filling and emptying. It is attached to the bottom of the cage by means of chains, and may be provided with a shoe to run in the slides the same as the cage. It consists of a conical shaped metal cylinder with two valves, a horizontal one near its lower end, and a vertical one immediately above but on the side. When it is being sunk in the water the valve will open and the water will rush in and fill the veil, immediately it begins to ascend the valve will close and the veil will remain full of water. To make it self-emptying I would have a chain attached to the vertical valve, and to a lever projecting over the edge of the mouth of the veil. At the point where it has to be emptied, I would have a piece of metal or wood projecting, so that it would come in contact with

the lever and raise the valve through the medium of the chain and allow the water to run out into cones provided to carry it away.

ANDREW HEPBURN,
5, Gladstone Street,
Burnbank,
Lanarkshire, Scotland.

Question 6—Describe the main and tail rope system of haulage, and discuss its advantages and disadvantages?

Answer to Question 6—

This system of haulage is only adopted where the road is of insufficient gradient to allow the empty hutches to draw the rope behind it, and for the purpose of drawing the empty rake a second rope is necessary, this rope is called a tail rope. The main and tail ropes are wound on separate drums fitted loose on the same shaft with a moveable clutch between the two drums, for putting whatever drum is necessary in gear while the other runs loose on the shaft, and is controlled slightly by a brake. (This clutch is not necessary except where the tail rope is only required part of the road, and if the tail rope is required all the road, both drums may be fitted on the same shaft also.) The tail rope is conducted from the drum and passes along the side of the road, and is supported by means of small pulleys that are fixed on iron standards, these standards are bolted on props that are placed along the side of the road, the standards are placed about 2 feet from the top of the props, the tail rope being conducted along over the top of the pulleys to the extreme end of the road, it is passed round a vertical wheel about 5 or 6 feet in diameter, then it is brought back to the bottom along the centre of the road and attached to the rake, so that it is twice the length of the road. The main rope is the length of the road, and is wound on the drum when the rake is at the bottom, and the end is attached to the end of the rake, so that it takes three lengths of rope for this system of haulage. Speed 6 to 10 miles per hour. Advantages.—(1st) Only a single road is required for this system of haulage, and that side branches are more easily managed. Disadvantages.—(1st) The great length of rope required to be dragged. (2nd) The great speed that this haulage is run causes considerable damage to ropes, hutches, &c.

DAVID SMITH,
10, Glasgow Road,
Burnbank, Hamilton.

Question 7—State the best methods of fastening tubs to the rope in the endless rope haulage?

Answer to Question 7—

For this method of haulage jiggers are generally used where the inclination is very great, the best method is to have a jigger on each end of the hutch, this makes the hutches run easier and prevents them from being twisted to one side as in the case when one jigger is used; also it prevents damage being done to rope owing to the turning effort of the jigger.—(2) Where the inclination is not very great a jigger fixed on one end of the hutch suits very well.

Another method for slight inclination is a bogie with clips or screw, the method of attaching the clips to the rope is, the rope is lifted into the grove of the clip by means of a small rod of iron turned at one end, the screw of the clip is then turned until it tightens the rope in the groove, the bogie being attached to a number of hutches they are set in motion.

FRANCIS HAILSTONES,
4, Windsor Street, Burnbank,
Hamilton,
Scotland.

Question 8—How would you deal with a gob-fire?

Answer to Question 8—

In dealing with gob-fires it would greatly depend upon its situation as to the best method to adopt, some prefer filling it out which of course would be advisable providing it may readily be got at and has not extended very far, but should it be near a pack or of an extensive nature, I would first get as near to the seat of fire as possible, and if water were available I would try to drown it out by that means, should I fail in this I would seal it off, selecting the most suitable places for the stoppings, having as few as possible choosing a solid and sound place for them of small sectional area, and in arranging for them I would have them put in as nearly as possible at one time, except at the point where the intake air enters, that is, I would stop off where the air came out first, and so continue till I came to intake, as this is progressing I would arrange if possible to send in a good supply of nitrogen and carbonic acid, as this and the products of combustion together will help to extinguish the fire, and also render fire damp or $C H_4$ non-explosive, should any be present. The dam being made up of any material (non-combustible) and well plastered with clay or fire clay; some have tried firing barrels of gunpowder with very poor results; after the whole is completely stopped off N and $C O_2$ may be passed in through a pipe and thus prevent the breathing of the fire.

THOMAS WALLETT,
Heworth Colliery,
Felling, R.S.O.,
Durham.

Question 9—If an anemometer registers 2000 in a minute in a semi-circular archway, the distance from the crown to the floor being 10 feet, and width 12 feet. What quantity of air is passing through this airway per minute?

Answer to Question 9—

The area multiplied by velocity equals quantity. To find area of this archway, divide it into two forms,

1st—$12' \times 4' = 48$ft. area of oblong part.

2nd—$6' \times 12' \times \cdot 7854 = 56 \cdot 5488$ft. area of semi-circular part.

Then quantity equals $104 \cdot 5488 \times 2000 = 209097$ft. passing in airway per minute.

J. WATSON,
56, Diana Street,
Newcastle.

Question 10—Where are the silver producing districts of the world, and what percentage of silver is found per ton?

The answers to this question were not of sufficient merit.—(Sub-Editor.)

PRIZES.

We will give 5s. to the reader that sends in the best Essay on "Sinking and Boring, and a consolation prize of "Mining," sent post free for six months.

⁂ ⁂

SILVER MEDAL Competition.

Trusting that our readers will appreciate our offer of a Silver Medal, perhaps even before money prizes, we are commencing a series of Competitions for Silver Medals, in various subjects. These will form one of the best testimonials of knowledge that it will be possible to acquire. Further particulars of this competition will be found in our next number.

⁂

We will give a uniform reward of 1s. for the best original answers to the following questions. All competitions are subject to the rules given below:—

1st—All envelopes must be marked "Competition."

2nd—To be written on one side of the paper only.

3rd—Correct postal name and address must be sent.

4th—They must reach us by *January 9th, 1893.*

Question 1—If a fireman finds gas in a working place when making an inspection after commencing work, what is he required to do? And what is the duty of the Underlooker or Undermanager?

Question 2—In a mine worked by longwall, the face is advancing towards old workings. How would you proceed?

Question 3—A return air current travelling along an airway 4′ × 5′, velocity 500′ per minute, is charged with gas at its most explosive point. How much fresh air is required to dilute it, so that it would not 'show' in a safety lamp, which 'shows' 5 % ?

Question 4—How can Iron or Steel be used instead of Timber underground? Give examples.

Question 5—Describe the Chaudron method of shaft sinking?

Question 6—What are Coal, Ganister, and Bituminious Shale?

Question 7—How can Galena and Zinc Blende be separated, and how is the process affected by Iron Pyrites in the Vein Stuff?

Question 8—What weight will break a beam of Memel Timber 6″ × 10″, resting on supports 10′ apart, load in the middle. The modulus of rupture being 10·386?

Question 9—How many gallons of water per minute will an engine of 70 Indicated H.P. raise from a depth of 100 fathoms?

Question 10—When fire-damp is burnt with air explosively, what is the nature of the products of combustion?

PRIZE ESSAY.

e have been compelled to ıold this prize owing to non- ›liance of our rules.

consolation prize has been ded to

G. W. Scougall,
9, Bell's Place,
Bedlington,
Northumberland,

ɜatness. "Mining" will there- ɔe sent post free for six months, n.

PUMPS.

HEN we speak of pumps we cannot fail to recognise the improvement that has been in this line of engineering in ɜction with mining. *Savery's* ɔing Engine was tried to drain ıines existing at that time, but ding to its mode of action h cannot be explained here, gh the shortness of this article) not fitted for pumping water any great depths. We next to *Newcomen's* Pumping Engine, the weight of the atmosphere ssed the engine piston and l the pump rods through the ım of a beam. It will be seen s case, that mines of any great could not be drained, because veight of the rods combined he weight of the water, would perior to the pressure on the e piston. *Watt* introduced his sh Pumping Engine, which marked improvement as com- with *Newcomen's* engine, he steam at the top of the piston press it, and it will be plainly that by using steam at a greater ure than that of the atmosphere, could be lifted from a greater ı, and have no hesitation in g, that the working of deep s of coal, is due to the invention of *Watt*. There are various modern pumps in use at the present time, such as *Davies* Compound Steam Pump, the Special Pump, *Evans and Sons* Direct-acting Pump, and the Pulsometer Pump, which may be used for temporary purposes. We shall now proceed to explain their application to pumping. The term pumping means :—"The raising of water by suitable machinery, when the atmospheric pressure is not great enough to do so, or where the water has to be lifted more than 34 feet," a little explanation here will be more satisfactory.—Supposing we erected pumping machinery to pump water from a depth of say 100 fathoms, well we would have the support of the atmospheric pressure, to a distance of 26 feet effectively, but according to theory, the exact distance is about 34 feet, but then the flow of water is very feeble, so this being the case, we must have some apparatus to raise the water to the necessary height minus the 26 feet of effective water column supported by the atmospheric pressure. When we want to put down pumping plant, we should consider the quantity of water to be raised in a given time, the distance to be raised through, before we can determine the size of engine necessary to do the work, also due allowance should be made for a great influx of water that might be met with, the thickness of the pump should be in accordance with the height of the water column. Also some method should be adopted to prevent corrosion of the pumps by acid water, after this is done, next comes the question of what sort of pump we want, and as their is advantages and disadvantages in nearly all classes, we can choose from the following:—(1st) The lifting

pump where the water is lifted a short distance from the well, standage or sump to the surface by means of a bucket, having suitable valves connected to spears working in the inside of the pumps, and such spears at the contrary end are connected to a beam worked by an engine, such as the Cornish Engine; the advantages are in this case as follows:—The engine is easily got at for repairs when necessary, also the engine cannot be drowned out through a great influx of water or stoppages. such as break downs; the working parts can be brought to the surface for repairs even when flooded up, the disadvantages are, the first cost is very large, and the necessary appliances take up much room in the shaft. The Plunger Pump is next where the water is forced to the surface, simply by the weight of the spears, the water in this case has not to be lifted, the advantages are:—The weight of the spears force the column of water to bank, and the cost and other things are the same as in the former case, the disadvantages are also the same as in the former case. The Special or Forcing Pump placed at the pit bottom where the water is taken from the sump and forced by rams through the column of pumps to the surface; advantages — first cost is small, working cost is small, and takes up little room in the shaft; disadvantages are:—The engine might be rendered useless for a time by being drowned out, difficulty of making water tight joints, also difficulty in securing clacks to withstand the enormous pressure. Therefore in conclusion, we must say a great many things have to be considered before selecting any system of pumping.

(To be continued.)

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MINING

A Journal devoted to the interests of Mining.

No. 4. Vol. I. JANUARY 12TH, 1893. FORTNIGHTLY ONE PENNY.

An ADDRESS by Mr. C. M. PERCY on COAL & COAL MINING.

ON Monday Evening, December 5th, Mr. C. M. Percy, of the Wigan and District Mining and Technical School, delivered an inaugural address, at Huyton, in connection with a system of technical instruction now being arranged for that portion of the County of Lancaster.

Mr. Percy, after dwelling a few minutes on "Coal and the Coal Industry." "The purposes for which coal is used," "Coal consumption dependent on foreign trade," "The importance of coal to England," and "Ancient and modern colliery appliances," said he purposed directing his remarks on that occasion chiefly to the subject of machinery for the ventilation of mines, and possibly at some future time would have other opportunities of taking up other portions of his subject such as hauling, pumping, winding, and compressed air. There was hardly anything more interesting about a colliery than the ventilating appliances, without which neither men nor animals could live in a mine, and without air, seams of coal would be valueless.

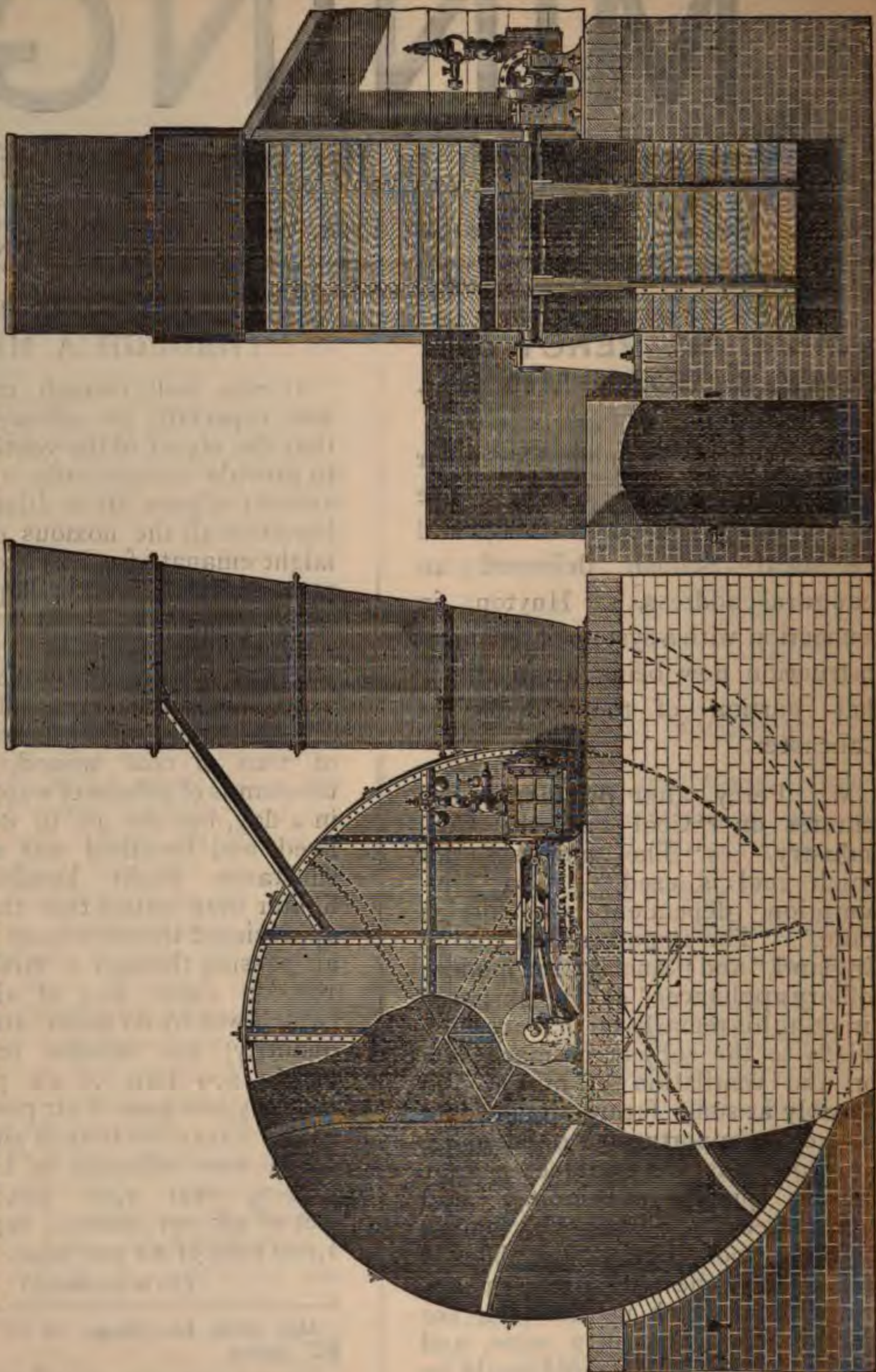
QUANTITY OF AIR PASSING THROUGH A MINE.

It was well enough understood, and especially in colliery districts, that the object of the ventilation was to provide continuously a sufficient amount of pure air to dilute or make harmless all the noxious gases that might emanate from the coal, and to preserve for the workers a practically pure atmosphere, but it was scarcely realised how enormous a volume of air was produced by the various ventilating appliances. They were all well acquainted with the hundreds of tons of coal wound, and the thousands of gallons of water pumped in a day, but the air in which they lived and breathed was so light a substance (eight hundred times lighter than water) that they hardly appreciated the enormous weight of air passing through a mine. Each 100,000 cubic feet of air current (which was by no means an excessive quantity) per minute represented nearly 200 tons of air per hour, nearly 5,000 tons of air per day, and nearly 2,000,000 tons of air per year. There were collieries in Lancashire passing near upon 500,000 cubic feet of air per minute, representing 1,000 tons of air per hour.

(*To be continued.*)

One cubic foot of air at 60° F., weighs 527 grains.

Torricelli thought of the Barometer 200 years ago.



GUIBAL FAN
WITH IRON CASING AND ENGINE.

PLIED MECHANICS .ATING TO MINING.

CHAPTER II.

:̣ shall briefly describe each of the most important and ılly employed fans of the ıt day, commencing with ɔne known as the Guibal -it must not be taken to by beginning with this one, it is the most important, ıgh it is certainly most generally It is one of the kind known :entrifugal," that is, it depends its results upon the "Inertia of r," or which is the tendency of dies when unrestricted to move 'aight lines. The fan (see ation) itself consists of a revolv- 'heel, having blades inclined 'ards and curved off in the ite direction at the tips. The ters the fan at both sides, but ; it at one particular aperture mney, whose discharging area ılated by a sliding and adjust- shutter, the chimney being at the top than the bottom, 'ucted in this manner so as to reduce the velocity and resistance with which the exhausted air meets the atmosphere. The principle upon which the fan works, is the fact that after the air enters the centre of the fan and reaching the circumference is thrown off owing to the "Inertia of Matter," and as a consequence a partial vacumn is caused in the fan—air rushes up from the pit and this establishing a current of air—ventilation is produced. The fan is driven by an ordinary horizontal steam engine attached by the crank to the fan shaft upon which the fan revolves. Two engines should always be arranged, so if one breaks down the other can be instantly coupled up to the fan. We shall not be able in this article to give the method of calculating the amount of air exhausted by fans of any given dimensions, but will endeavour to do so in the next, together with several important improvements that have been accomplished in connection with the Guibal Fan. The illustration is one of a fan made by Messrs. Thornewill and Warham, Burton-on-Trent, whose fans have given universal satisfaction.

(To be continued.)

In Loving Memory of

SIMON ASHCROFT, aged 14	**HENRY EDWARDS**
WILLIAM BACHE	**RICHARD FAIRCLOUGH**
JOHN COBLETT	**JOHN HARRISON**
GEORGE CLAREY	**JOSHUA MANN**
MICHAEL CAVE	**CHARLES MANN**
JOHN DOLAN, aged 13	**JOSEPH MILLS**
JAMES DOWES, aged 26	**JOHN OVINGTON**
WILLIAM EVANS	**WILLIAM OWEN**

JAMES TOWEY, aged 26

Who lost their lives through the Burning of No. 2 Coal Mine, at Bamfurlong, near Wigan, December 14th, 1892.

Little we thought our time so short
In this world to remain,
When from our homes we went away,
We thought to come again.

Be warned by our sudden call,
And you for death prepare.
For it will come—you cannot tell
The manner, when, or where.

HAULAGE.

Chapter IV.

No doubt many of our readers have read of the sad accident which has happened through the upsetting or exploding of a paraffin torch used to prevent the formation of ice in the passages and exhaust ports after compressed air is used, we are not criticising the methods that have been adopted to prevent this occurring, but merely to explain how it is that compressed air freezes in the cylinder and consequently the formation of the ice around the exhaust ports, etc.

COMPRESSED AIR FOR HAULAGE.

In this article we shall only briefly state the chief advantages and disadvantages of compressed air as used underground for the purposes of haulage, etc. Air is of course compressed on the surface by means of air-compressors and conducted to the haulage engine below by means of pipes—it can be used for all the purposes where steam is used, as for pumping, drilling, and coal getting machines, etc., the advantages are:—(1st) It can be used anywhere in the mine. (2nd) It helps ventilation. (3rd) There is nothing to be removed after it has done its work, as in the case where steam or water are used. The disadvantages are:—(1st) Greater cost. (2nd) Tremendous loss of power, as the following will explain—When air is being compressed a large amount of heat is produced, which is equal to a great amount of work lost, this heat becomes so enormous that the cylinders of the air-compressor would become red hot, if the heat were not conducted away usually by means of water. The air when compressed is used to perform mechanical work, say in the hauling engines, in doing this it expands, the expansion requires more heat and consequently the air often falls below freezing point 32° F, which then forms ice in the passages where used and at the exhaust ports. When compressed air is used the exhaust ports should be of *large* size and also *short*, this will to a certain extent prevent the freezing and consequently the necessity of raising the temperature of the frozen parts by means of torches, etc., when such happens.

ELECTRICITY RELATING TO MINING.

Chapter III.

Before the reader could thoroughly understand the action of an *Electric Bell* we shall have to know that there are two kinds of magnets, first what are called Permanent Magnets and second Magnets that only have that power while under the influence of an electric current. If we take a piece of loadstone ($Fe_3 O_4$) and rub it along a piece of steel, the steel becomes a permanent magnet (prove this by it attracting needles, iron filings, etc.,) but if the loadstone was rubbed along a piece of very *soft* iron it would *not* become a magnet; now let us wind about 6 feet of Cotton covered copper wire round a bar of *soft* iron and attach the ends of the wires to the *Zinc* and *Carbon* terminals of our Le-Clanche Battery we shall find that the soft iron has become a magnet, and immediately we disconnect one end of the wires the iron ceases to become a magnet—this most important fact is the actual

action that takes place while an electric bell is ringing, and in our next article we commence to describe in detail the construction of the electric bell.

The above illustration represents one of the latest forms of the electric "Dry Battery" mentioned in our first article, as the contents are a trade secret we cannot explain it to our readers, and may say that this is one of the best forms of batteries that can be used for ringing bells, and are manufactured by Messrs. Davis and Sons, Derby.

(To be continued.)

GEOLOGY.—"By Retso."

Chapter III.

WE thus see that ice has left marks of its destructive action not only in England but in nearly all parts of the world, particularly by the presence of grooved and polished rocks in masses of earth, by leaving and transporting huge blocks of rocks at a great height up mountain sides, etc.. These distinctive memorials are left for ages after the ice has gradually receded further North, by them we know that the Glaciers of the Alps were once part of this huge field of ice that covered Europe. There are various other agencies by which the earth has undergone great changes, and now we will see a few of these that have been altered by the *Sea*. They are of two kinds, *first*—the wearing away of the land, and *second*—the building up in other parts. The constant erosion of the rocks has a good example in the Shetland Islands, Scotland, were the sea dashes with a force calculated to be about 3 tons per square foot and bringing down as much as 15 tons at a time from a height of 100 feet above the sea level. Everywhere, where there is a rocky coast line we have a good illustration of the constant wearing away by this wonderful transformer, as an example we may take a part of the East Coast of Yorkshire, where it is gradually being worn away at the rate of about 2¼ yards every year, in fact we have proofs that since the Roman period over 3 miles has thus disappeared. The rate of wearing away caused by the sea, may be taken as a fair average about 12 feet per century, so that at this rate it will take 44,000 years to wear away one mile of land. But while this is going on there are other ways, whereby the land is gradually being built up, and in my next article I shall deal with these and also show how it is supposed what formed our original coal beds.

(To be continued.)

Smeaton built a 72″ cylinder engine in 1764.
Watt invented the separate condensor in 1765.
Newcomen invented the first beam engine.

ANSWERS TO QUESTIONS.

Question 1—Give an account of working a thick coal with a bad roof?

Answer to Question 1—

The term "thick seam" is rather indefinite as a seam of about 5′ might be termed a thick seam, while in other districts would be called a comparatively thin seam. Therefore, I will describe the working of a seam 9′ thick with a bad roof. The method of working the coal is that of common Bord and Pillar (Stoop and Room). In working the whole 2′ 6″ of top coal is left to support the roof until the "Broken" is commenced. It is taken down as follows—A lift of bottom coal is taken of the pillar, when props of about 5′ or 6′ long are used to support the roof, when the lift is finished the men start to bring back the top coal, this is done by drawing a limited quantity of the props put in to support the top coal when the bottom coal is being taken out. When the props are drawn the top coal generally falls itself and then long props of about 9′ in length are put in to support the roof; this method is carried on until the whole of the lift is out, and then, finally, the long props are drawn and the roof allowed to fall. A great advantage obtained by this method of working is, that when the top coal is dropped it gives a large percentage of round coal.

J. RIDDLE,
Delight Bank, Dipton,
Co. Durham.

Question 2—At what rate will it be necessary to work a 12″ pump, stroke 9′, to keep down a flow of 200 gallons of water per minute, in a shaft 200 yards deep. What will be the H.P. required?

Answer to Question 2—

In order to find what rate a pump must be worked to keep down a certain flow of water we must ascertain what the barrel or cylinder will hold, according to the question the rate will be found as follows: $12 \times 12 \times {\cdot}034 \times 9 = 44{\cdot}064$ gallons of water the pump barrel holds, and dividing the flow of water by 44·064 will give the necessary rate that the pumps should be run at.

$$\frac{200}{44{\cdot}064} = 4{\cdot}503 \text{ strokes per minute}$$

practically 4·5 strokes. The H.P. of the engine to work this pump

$$\frac{200 \times 10 \times 200 \times 3}{33000 \times {\cdot}5} = 72{\cdot}72 \text{ H.P.}$$

A modulus of ·5 is generally used for pumps.

G. W. SCOUGALL,
Bell's Place,
Bedlington,
Northumberland.

Question 3—Give an outline of the methods of separating lead and blende ores from sparry vein stuff.

Answer to Question 3—

The following are the outlines of the different methods of separating Lead and Blende ores from sparry vein stuff at the Nenthead workings. The vein stuff is first passed through a large crusher such as Blake's stone crusher, it is then raised by elevators or buckets to six classifiers placed in order. These classifiers are made of cylindrical wire gauze, the apertures of the gauze being largest in the first and smallest in the last, the vein stuff is carried through the

nning water, the "gangue" through these classifiers .ing to the size, and are con- into long oblong boxes called :rs." These are divided into visions, water on one side and e on the other bedded with re. As the vein stuff passes :he bedded sieve, the water is up and down by a level bond ıus causes a vibrating motion other side causing the heaviest of ore to be deposited on the ›edding. The fine pieces of t treated by these jiggers are l on to a large buddle called ›nir buddle. This consists of › round table sloping from the to the circumference. The ime is carried on at the centre, s the table moves round the ;ue" falls off first, the blende :xt, and the lead ore last, owing ir Specific Gravity. It is then :ed and ready for market.

FRANK GRAHAM,
Park Terrace,
Low Lane,
Durham.

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stion 4—What are the best ›ds of preserving the timber ınderground ?

to Question 4—

› most serious cause of the of mine timber is the chemical set up by the vital action of ›tton mold fungus, and many ıes have been tried to protect nber from the injurious effects ; fungus ; it has been proposed ›se water to trickle down the r and by this means good has done, but it is an expen- ınd impracticable proceeding. ing the timber in salt brine has been tried but with only moderate results, the sulphates of copper, zinc, and iron have each been tried with very moderate results, charring the surface of the wood with fire has been tried and failed, coating the surface of the timber with coal tar and whitewashing with quicklime has been tried with very moderate results, as the skin of the timber only is effected and the result is, when the timber dries it cracks and the germs of the cotton mold fungus at once enters and destruction begins. Up to the present time the best method of preserving mine timber is by the application of creosote in the process of creosoting, for by this process the timber is permeated or filled to the very core with the preservative. Creosote, is an oily, colourless liquid, obtained from the distillation of tar, it is preventative of fermentation and putrefaction, the action of the cotton mold fungus being to first set up fermentation in the wood and then destroy it, is thus prevented by creosote, which stops its fermentative action, the creosote for wood should be rich in naphthaline.

WM. SWAN,
5, Brown's Buildings,
Crow Hall Lane,
High Felling,
Co. Durham.

Question 5—Where and how can Iron be used instead of Timber underground ?

Answer to Question 5—

Iron may be used to advantage as a substitute for timber underground in securing pit bottoms, main haulage roads, return airways, and any place where it will require to stand for a considerable time. It may be used in combination with timber or brick-

work, or it may be used exclusive of any of these. When used in combination with timber, the iron girder will extend across the road and be supported at both ends by timber legs resting on the pavement. Iron chairs for the girder to rest in could be fixed on the top of each support. When used in combination with brickwork, the girder is supported at both ends by a brick wall and may rest in a chair the same as when timber is used as supports. When used exclusive of timber or brickwork the girder will require to be supported at both ends by iron (or if the side wall are strong the ends may be notched into them and wedged tight). The iron supports will be hollow beams with flanges at each end connected by a web. If made of wrought-iron both flanges may be the same size, if made of cast-iron the flange in tension will require to be from three to five times larger than the one in compression. The supports will be fastened to the girder by bolts and chairs. Old permanent rails and chairs are extensively used in combination with timber and brickwork, iron ones being preferable to steel as steel gives no warning before breaking.

ANDREW HEPBURN,
5, Gladstone Street,
Burnbank,
Lanarkshire.

Question 6—Give a clear outline of the plant and machinery required for working rock drills at a considerable distance from the shaft?

The answers to this question were çopied from books, etc., and in several cases were written word for word.—Sub-Editor.

Question 7—Give an account of the principal lead mining districts *Europe?*

Answer to Question 7—

Beginning with the British Isles we find large supplies of ore in the form of Blende, traversing the Carboniferous Limestone and Millstone Grit series in the following districts—Alston Moor, Weardale, Wensleydale, Tusdale, Swaledale. In the same series we have lead veins in Derbyshire, near Bakewell, also in North Wales, at Holywell, Wrexham. In all these localities blende is associated with flour spar, calcite, heavy spar and quartz. In rocks of Silurian age, veins containing blende are found in the Isle of Man, Cardiganshire, Montgomeryshire, Shropshire. In rocks of the Devonian age, veins of blende are found in Cornwall and Devon. In the same rocks on the continent in the neighbourhood of the following rivers—The Rhine, the Lahn, the Seig. The ore in Devonian strata, is as a rule richer in silver than the ore in Carboniferous strata. In the following countries and districts rich deposits of lead ore are found in veins traversing Silurian strata, as in Spain, Almeria, Adra, Carthagena.

WILLIAM ROBSON,
126, Church Street,
Walker-on-Tyne.

Question 8—When the water gauge read 2·4 there were 150,000 cubic feet of air passing per minute. What was the H.P. of the furnace?

Answer to Question 8—

As H. P. is represented by 33,000 lbs. or units of work, quantity reduced to lbs. and ÷ by 33,000, gives the H. P. of furnace and is found as follows—

$$\frac{150,000 \times 2{\cdot}4 \times 5{\cdot}2 = 56{\cdot}72}{33,000} \text{ H.P.}$$

JAMES WEIR,
18, Sunnyside Terrace,
Couthridge, N.B.

Question 9—In a colliery the quantity of air circulating was 70,000 cubic feet per minute, the water gauge was 1·5 inches. What is the H.P. in the air? If the ventilation was increased to 100,000 cubic feet per minute, other circumstances remaining the same, what will the water gauge be?

Answer to Question 9—

The H.P. $= \frac{70,000 \times 1{\cdot}5 \times 5{\cdot}2}{33,000} = \frac{\text{H.P.}}{16{\cdot}6}$ nearly

In mine ventilation the resistance increase as the square of the velocities, and if the areas are the same as the square of the quantities, therefore the W. G.=

$$\frac{1{\cdot}5 \times 100,000^2}{70,000^2} = \frac{1{\cdot}5 \times 10^2}{7^2} = \frac{1{\cdot}5 \times 100}{49}$$

$$= 49)150(3{\cdot}06$$
$$\begin{array}{r} 147 \\ \hline 300 \\ 294 \\ \hline 6 \end{array} = \text{W.G.} = 3{\cdot}06 \text{ nearly}$$

WILL. LITTLER,
234, Woodhouse Lane,
Wigan.

Question 10—How would you work a seam of coal 30ft. in thickness?

Answer to Question 10—

The heading in these seams are first of all driven right to the boundry in the lower coal, or sometimes in the middle of the seam, whichever is most suitable. When the boundary is reached a panel of work is then made with about ten pillars, each pillar being ten yards square, with the side roads ten yards wide, then the bottom part is removed first, only pillars being left to support the roof and upper part of the seam. After the bottom part of the seam is all taken out on every side of the pillars, they next nick up the sides of every pillar and take the top coal down alternately until the pillars are the height of the seam. All the pillars are left in then for six or eight years, by which time the roof in the openings has fallen, then they go back and get them out by undermining them.

WILLIAM ROBSON,
126, Church Street,
Walker-on-Tyne.

QUERIES BY READERS.

ARE MINING INQUESTS PROPERLY CONDUCTED?

THERE is no doubt that the above subject *must* be of the greatest interest to all the Mining community.

R. D. R. amused me immensely by his opinions, and I have no doubt that his knowledge of the subject of mining is very meagre; he says, "that juries are often composed of the local tradesmen, etc., who cannot have any knowledge of the working of a colliery." Now I shall be deeply indebted to him if he will answer me the following:—(1) Can he quote a single case where the jury had not sufficient evidence given to them, so that they *thoroughly* understood the nature of the accident upon which they had to decide. (2) Is there not the Inspector of that district watching on behalf of the country? (3) Does he deem it requisite to have a jury composed of men with a substantial knowledge of the pit. (4) If a representative collier of the pit, where the accident has happened, is to watch the inquiry, who will pay him for his trouble and expenses.

No, in my opinion I think R.D.R. has struck the wrong track, all that he suggests is that our present mining juries want altering, and yet has not offered a suggestion for their alteration. Trusting this letter will be inserted in your next number, and thanking you for the encroachment on your valuable space.

I remain, yours faithfully,

"A Tradesman Juryman."

Wigan.

ANSWERS TO CORRESPONDENTS,

Propwood.—Sorry that we could not accept your article.—(2) Yes; we will read the Mining tale if you send it in, and if suitable will insert it.

Pit Lad.—Glad you prefer our style to that of filling the Journal with long division sums. Thanks for the Mining bits. You will see that two or three are in this number.

Collier (Golborne).—Yes, it is a form of decay; the only method to prevent it is that known as creosoting

Deputy (Glasgow).—We will write to you by post, giving the information necessary as it would occupy too much space in these columns.

Mining Student.—You had better get Goodeve's Mechanics and S. James's on Ventilation.

Chocker (Hindley).—You no doubt may have a great deal of trouble, especially through side weight. Glad you like our journal, we may say that it will be considerably improved in our future numbers.

A. L. G. (Durham).—The formulæ you name is hardly correct, the best one we know is—

$$L = \frac{F + T + M}{W - W - M''}$$

that is using the same letters as you.

Underlooker.— Thanks for your letter, we have sent you particulars, with posters, bills, &c. The articles you name are in the course of preparation, and will appear shortly.

X. Y. Z. (Bury).—We cannot recommend you to adopt such a course. Thanks for the articles—we have written you stating terms, &c.

Opaque (Wales). — There are several books on the subject you name, but will be far too advanced for you, we know of no really good elementary book. Pleased to hear you like our paper so much.

A. C. P. (Pemberton).—By all means try for the Prize Competitions—only be careful not to use matter copied from books.

Sinker.—The average rate, as a rule, is about 8/ per day. The following rule perhaps will suit you.

$$D = \sqrt{\frac{W.H.}{624 \cdot 32 \times 2}}$$

F. S.—Thanks for your letter. We note contents and will reply later.

PRIZES.

SILVER MEDAL Competition.

As announced in our last number, we intend to offer Silver Medals for various competitions that will be announced from time to time.

The first one will be for the best series of SHORT articles on the following subjects:—

Sinking	Boring
Pumping	Timbering
Winding	Mechanics
Haulage (any system)	Ventilation
Methods of Working a Seam	

This will take more the form of a test in any or all the subjects, and one or all of the subjects can be attempted. Any formulæ or notes can be written, and we leave it solely to our readers as to the methods of describing—only the article must be as brief as possible—book-work will disqualfy.

These Medals will form a handsome testimonial, and one of the best certificates of proficiency that it is possible to obtain.

All articles must be fastened together, and reach us not later than February 6th, 1893.

We intend to give a number of Questions that have been asked at Examinations for Managers, Under-Managers, and at the Science and Art Examinations, for which we shall give a uniform reward of 1/- for the best original answers, subject to the following conditions, which must be observed in all competitions :—

(1) To be written on one side of the paper only.

(2) The name and postal address must be attached to every answer.

(3) They must reach us by January 23rd, 1893 (except "Silver Medal" competition).

(4) Write "Merit" on left-hand corner of envelope.

Question 1.—How many gallons of water a minute will an engine of 80 indicated H.P. raise from 150 fathoms ?

Question 2.—How loog will it take an air current of 30,000 cubic feet per minute to make a circuit of an airway 12′ high and 8′ wide, and 3,500 yards long ?

Question 3.—Describe a Longwall method of working a seam with a high dip ?

Question 4.—How would a volume of 150,000 cubic feet of air and gas be affected if the barometer fell from 31 inches to 29 inches ?

Question 5.—Describe in detail and compare with sketches the Stephenson, Clanney, and Muesler Safety Lamps.

Question 6.—Describe how you would make a survey with a common miners' dial.

Question 7.—What power and appliances would you consider necessary for drawing 600 tons of coal in ten hours from a depth of 400 yards (give some of the leading dimensions of plant — engines, boilers, etc.—that you would prefer).

Question 8.—You have a straight main road, 1,500 yards long, regular gradient of 1 in 50 falling from the shaft, up which a large quantity of coal has to be brought, what arrangement would you adopt and what provisions of the C.M.R.A. would you have to observe ?

Question 9.—"TIMBERING."—Discuss the relative merits of (*a*) Steel Girders; (*b*) Iron Girders; (*c*) Larch Timber; (*d*) Norway Timber, for "barring" purposes.

Question 10. — How are ores cleaned from waste materials ?

Robinson thought of the road engine in 1759.

J. Watt used packing for pistons in 1768.

MINING DUST.

To render Petroleum inexplosive, mix in the following proportions:—

Petroleum, 40 gallons.
Sulphate of Copper, 2lbs.

***

It is proposed to run an Electric Railway from Clapham Junction to Paddington.

***

A Shilling consists of a composition of pure Silver, 92 parts and Copper 8 parts.

***

Fog Signals are nearly all manufactured in Birmingham, they consist of three tins, one inside of the other, in the innermost Gunpowder and Caps are placed.

***

The second largest Diamond in the world is now being cut in Antwerp, and roughly is about the size of a Pigeon Egg.

***

Asbestos is found chiefly in Italy, where the supply is practically inexhaustible. Susa Valley is where it is mined.

***

We have received a copy of that excellent paper, "The Labour Tribune," and also the Almanac for 1893. This forms an interesting reference, being full of Mining matter, and cannot possibly fail to be of the greatest interest to all our readers. The centre of the Almanac is occupied by a portrait group of the 'Miners' Congress' at Westminster, and is published for the small amount of 1d., 1½d. post free, from the Editor, "Labour Tribune" Office, West Bromwich.

The following are the four best Mining Jokes that have been sent in, and therefore

W. Littler,
234, Woodhouse Lane,
Wigan,

receives "Mining," post free for six months for his trouble in sending them.

MINING JOKES.

Pat (to Hooker-on) "Let me up again, plaise."

Hooker-on: 'Why, what's to do?'

Pat: "Be ghorra, oi make no coont of workin' in a country where the wurld shtands upon shticks!"

***

Collier (to Fireman): "My place isn't fit to work in—it isn't fit for a dog to be in—send the datallers in."

***

Collier (to Fireman): "Send a dataller, Bill, as soon as tha con."

Fireman: "What fer, Jack?"

Collier: "It's weet, here, an' I want a dataller fort' kneel on."

***

O'Hara (to Under-Manager): "Can you find me a place, sir?"

Under-manager: "Yes, but the hours are rather long—from 5 in the morning to 7 at night."

O'Hara: "Couldn't you reverse the hours, sir, since the hours world be the same. I could start at 7 in the morning and leave off at 5 at night.

Printed and Published for the Proprietor by Strowger and Son, Clarence Yard, Wallgate, Wigan.

MINING

A Journal devoted to the interests of Mining.

No. 5. Vol. I. JANUARY 26TH, 1893. FORTNIGHTLY ONE PENNY.

An ADDRESS by Mr. C. M. PERCY.

COLLIERY VENTILATION, ANCIENT & MODERN.

A comparison of the ancient and modern methods of colliery ventilation would show the enormous changes that had taken place. In early days there were no appliances at all, the natural heat of the mine, or a lamp placed at the bottom of the upcast, being sufficient for what was considered necessary. Then they utilised falling water to give the needful momentum to the descending current, or a steam jet to supply the requisite momentum to the ascending current, but with the great depths that had been reached, and the extensive workings which were so general, something very different was required. The two systems of colliery ventilation at present in use were known respectively as the furnace and the mechanical, and it would be interesting to say a few words about the principle of each system.

FURNACE VENTILATION.

In furnace ventilation they had a large fire at the bottom of the upcast shaft, the heat rising from which acted upon the column of air in that shaft, and by expanding it made it lighter, and it rises. By so doing colder air was drawn down the downcast shaft and through the workings. The two columns of air might be likened to two sets of weights in two scale pans. The lighter set rises, and the heavier set falls, and so a current is produced and maintained. There is no more effective system, especially for deep pits, than the furnace, but a fire in a mine is not only not desirable but in many cases dangerous, and the smoke from the furnace does damage to the shaft and to the surroundings of the colliery at the surface.

MECHANICAL VENTILATION.

Mechanical ventilation is now very general, and will probably become universal. There were various machines, but he purposed only dealing with that which was most extensively used, namely—the fan. It was the most effective, the most simple, and the least likely to get out of order. The principle of the fan is very beautiful and very easily understood. In its simplest form a fan is merely a double-revolving disc, the two sides connected by plates, and the air entering at the centre on one side or both, and passing out at the circumference, There is a well-known law of nature that all moving bodies, no matter how heavy, and no matter how light, endeavoured to travel in straight lines and offered resistance to any divertion from the straight line. Water, air, and steam

(*To be continued*).

WINDING.

CHAPTER IV.

THE ADVANTAGES OF COMPOUND ENGINES.

THE greatest object in using compound engines over ordinary one cylinder engines and advantages are :—(1st) Steam is used at a high pressure. (2nd) It works by expansion. The aim in using steam either in one or four cylinders is to get the largest amount of work from a given quantity of steam. By using high pressure steam in one cylinder engines we see that the great disadvantages are :—(1st) The variation of heat in the cylinder is too great. (2nd) The strain on all parts of the engine is too great, and to show this by an example—let us suppose we have steam at 243lbs. absolute (absolute being pressure of steam per square inch + pressure of air per square inch = 228 x 15 = 243) then 243 ÷ 3 = 81 times that the steam becomes expanded. It must be plainly seen then that the variation of heat will be considerable—that the strain on all the parts of the steam engine will be 81 times as great at the beginning as at the end of the stroke, and no engine could work under these conditions. We will now use the same pressure in a compound engine, being 243lbs. per square inch absolute. In the first cylinder we should have 9 expansions, reducing the pressure from 243 to 27lbs. per square inch as

$$243 \div 9 = 27.$$

In the second cylinder we should have 9 expansions, again reducing the pressure from 27 ÷ 9 to 3lbs., then + the expansions in the two cylinders together as 9 x 9 = 81 (by which it will be seen we have as many expansions in the two cylinders as we had in the first example) the difference being that in a compound condensing engine it becomes much more practical to use these higher pressures than in a single cylinder engine.

We shall continue our article on and describe the Triple and Quadruple Expansion Engines, and compare and describe their advantages and disadvantages as far as the colliery winding engine is concerned. The illustration is of a Condensing Engine, manufactured by Thornewill and Warham, Burton-on-Trent, and has given every satisfaction wherever used.

(To be continued).

GEOLOGY.—"BY RETSO."

CHAPTER IV.

IN my last article I gave examples to prove that a large portion of certain Coasts are gradually being worn away by the action of the sea, although the sea wears away part of the land it actually *builds* up other parts, by washing up pebbles and stones of various sizes for ages. On the Sussex Coast we have a good example of this building up, for within record some 10 miles has thus been added. We will now understand how plants have left their records, and may take *Peat-Bogs* as an example. In Arctic Regions a moss known as bog moss flourishes, growing and then decaying until the mass gets to a depth often reaching 50 feet, and are called Peat-Bogs. In shallow lakes and the bottom of valleys, etc., this pulpy vegetation becomes gradually compressed, and the various grades are gone through until *Coal* is formed. The rate at which Peat-Bogs are formed is about 1'-6" in 10 years, they occupy about 4,000

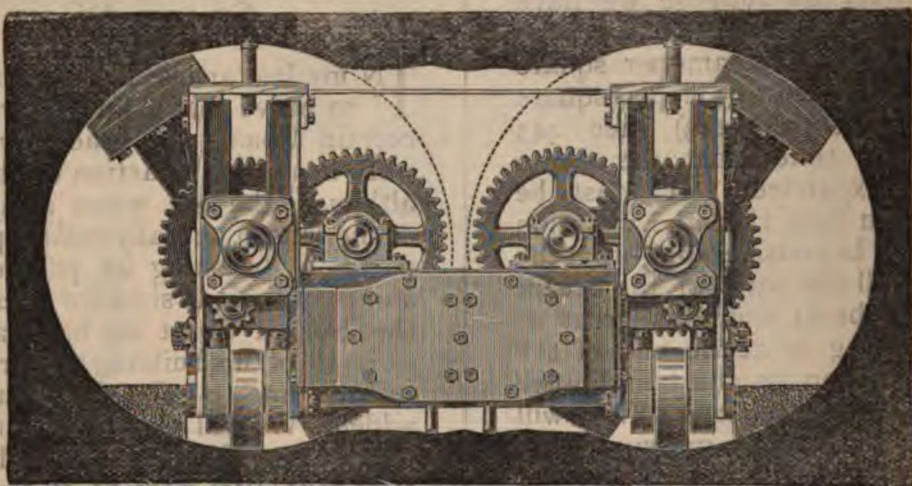
square miles in Ireland—where fine specimens of the Irish Elk have been found. Another good example where we can see the vegetation growing as it is supposed it grew when the coal beds where formed, are the "*Mangrove Swamps*" off the Coast of Florida, and consist of the mangrove trees growing into the salt water forming a belt of vegetation which fills in all the inlets of the Coast—these swamps are often 20 miles in breadth.

(To be continued.)

METHODS OF WORKING COAL.

CHAPTER IV.

THE illustration represents the double coal heading machine, made by Stanley Bros., Nuneaton; it is made stronger throughout than the single one, with extra gearing which makes it especially suitable for cutting seams with bands of "Clunch," "Bind," "Shale," etc.



The following are reports of the working of these machines in various seams :—

Nelson & Washington Collieries,
Teplitz, Austria.

I inform you that the machine I had from you is working in a first-rate style, and giving the greatest satisfaction. It is cutting the 6′ 6″ heading from four to six lineal yards *per day* of eight hours. I should say a fair day's work—including loading, with three men—would be five yards. We have no trouble at all with it, and we have cut a yard in one hour several times, and cleared the heading. It has satisfied everybody who has seen it.

Trabbock Colliery,
Drongan-by-Ayr.

The coal in which this machine was working is of the Splint nature and of an ordinary hardness, and is composed of 12″ free coal next roof, 3″ hard blue Splint, 28″ free coal, 2″ parting, 32″ free coal. The machine cuts a 5′ circle from top of blue Splint, rib down, and does fairly well, cutting on an average from 3 to 5 yards per shift of eight hours with three men. For week ending 12th March last, we cut 40 yards with two shifts of eight hours each, and working six days. We have scarcely

had a full week without a stoppage from some cause or other,—generally an accumulation of fire damp in the tunnel,—consequently are unable to give a very satisfactory testimonial. The machine is now standing because we have struck a large down-throw, but before stopping we cut into the stone,—which is a dark shaley blaes, with thin ribs of iron stone from 1″ to 1½″ thick,—a distance of 20 yards in twelve shifts of eight hours each with two men.

Bamfurlong Collieries,
Near Wigan.

When it is working on the end of coal it will cut 2′ in ten minutes when the pressure of air is 45 to 50lbs. per square inch; and when worked on the face it will cut the above distance in the same time with 10lbs. less pressure of air.

By the above we can see that the machine has given good results.

(*To be continued.*)

METAL MINING.

(From our Special Correspondent.)

It is with the deepest sympathy that I have to announce the occurence of another terrible calamity. The Wheal Owles Mine, situated about a mile north of St. Just, on the borders of the cliffs overlooking the Bristol Channel, under which the workings extend. There are many old workings at Wheal Owles and several setts have been discontinued, having become full of water. The catastrophe arose through some hundreds of tons of water being tapped. Numbers of the levels and winzes poured a continuous stream of water down one of the shafts, and rapidly filling up the lower levels, men and lads were speedily drowned. The first warning was a tremendous roar, following which came a rush of wind which blew all lights out, the men rushed to the shaft and were met with the falling water. With the present machinery none of the bodies can be recovered for at least two months, some being in fifty fathoms of water. The following are the names of the miners drowned:—

Ed. White	Joseph Eddy
Jas. Rowe	Wm. Roberts
Wm. Davy	Jas. Edwards
Thos. Ellis	Jas. Williams
Peter Dale	Jas. Thomas
Jno. Olds	Thos. Allen
Rd. Williams	Chas. Hitchens
Jno. Taylor	Mark Taylor
Jno. Grose	Thos. Grose

The man Davy had never been in a Tin mine in his life before, and for several it was their first day's work there.

ANSWERS TO QUESTIONS.

Question 1—If a fireman finds gas in a working place when making an inspection after commencing work, what is he required to do? And what is the duty of the Underlooker or Undermanager?

Answer to Question 1—

In a case like this, the judgment of the fireman is brought into operation, viz.:—*Is there a dangerous accumulation of gas?* If so, then according to Special Rule 29 of the C. M. R. A., "he shall withdraw the men, and shall fence off such place across the whole width, placing a danger signal at a sufficient distance from the point of danger, and report the same to the Undermanager (if any) or Underlooker, and enter a record of the same in his report book and also in the sudden danger book."

The place could then be cleaned at night. If, however, there was only a very small accumulation of no material consequence, he would remove it in the ordinary way with cloth, etc. According to Special Rule 16, the Undermanager and Underlooker "shall not allow any serious accumulation of gas to be removed except when the ordinary workmen are out of the pit," and by Special Rule 15, "he shall at once inspect personally such district of the mine under his charge as may be reported to him as unsafe, or in any way to need his attention, and shall remedy or cause to be remedied any defect.

WILL. LITTLER,
234, Woodhouse Lane,
Wigan.

Question 2—In a mine worked by longwall, the face is advancing towards old workings. How would you proceed?

Answer to Question 2—

According to General Rule 13 of the C. M. R. A., 1887, a pair of narrow drifts not exceeding 8′ wide should be set away. Each place should have at least one front bore-hole not less than five yards in length, and sufficient flank holes on the side, When the coal is not very solid and the pressure of the water in the waste workings very great it is good policy to have the holes more than five yards in advance (the distance varying with the nature of roof, floor and coal) and to do the boring through sluice valves having the bore holes tubed, as this allows a chance of the preparations being made complete so as to deal with the water in the best possible way under the circumstances.

JOHN COWIE,
Meadowhead,
Motherwell.

Question 3—A return air current travelling along an airway 4′ × 5′, velocity 500′ per minute, is charged with gas at its most explosive point. How much fresh air is required to dilute it, so that it would not 'show' in a safety lamp, which 'shows' 5%?

Answer to Question 3—

Area of airway = 4′ × 5′ = 20ft. Quantity of air passing = 500 × 20= 10,000 cubic feet. The most explosive point of gas is 1 of gas to 9·5 of air. When there is as much as $\frac{1}{50}$th % of gas, its presence can be detected on the flame of a lamp, so that for every cubic foot of the above mixture I would add 35 cubic feet of air, thus—10,000 × 35 = 350,000 cubic feet of pure air required.

WILLIAM ROBSON,
126, Church Street,
Walker-on-Tyne.

Question 4—How can Iron or Steel be used instead of Timber underground? Give examples.

Answer to Question 4—

Iron or steel can be used instead of timber underground as props in securing a longwall face, as crowns with ordinary legs, and as legs for such crowns. In such cases it is used in the form of old rails and principally in coal mines, chairs being keyed on to the rails when ordinary props are used, and a bent piece of iron is placed between the leg and crown when rails are used for the legs. The rails are in some cases used in the ordinary manner, being placed against the roof in the same manner as ordinary crowns, in other cases the roof is cut out to allow the rails forming the crowns to form a semi-circle. In metal mines in very soft strata the rails are bent

into the form of a gothic arch and a thin sheet of iron placed behind them to prevent any of the material forming the roof or sides coming in.

JNO. COWIE,
Meadowhead,
Motherwell.

Question 5—Describe the Chaudron method of shaft sinking ?

Answer to Question 5—

The Chaudron method of putting a shaft through water bearing strata, where the pumping would be of the most costly nature and the water in some cases from two to three thousand gallons per minute or even more, is the cheapest and best It is a system, strictly speaking, not of sinking, but of boring a pit. The apparatus is only a modification of the primitive modes of boring. The borehole or shaft is advanced, first by boring a hole or shaft from three to five feet in diameter, and this is done by a tool called the small Trepan. This hole is generally kept about sixty feet in advance and serves four purposes, First—To lessen the area of cutting surface in the pit bottom for the large Trepan. Second—For the storage of cuttings from the large Trepan. Third—To act as a guide for the large Trepan and keep it concentric. Fourth—To collect all debris for the sludger. A steam capstan is used for raising and lowering the rods. After the pit has been bored with this apparatus the next important matter is inserting the tubing, the tubing consists of cylinders four feet deep, and cast to full size of the pit. The flanges are turned in a large lathe, and are put together with water-tight joints, secured with bolts. The tubing is lowered into the shaft in a very peculiar manner. A cylinder is cast with a flange inside at the top, and a flange next to the rock side at the bottom. This bottom ring is made so much smaller than the ordinary tubing that it slides inside of it. On the outside of this cylinder is a mass of peat moss, this bottom ring is called the moss box and is a stuffing box; the bottom edge of this ring above this is made with a flange and acts on the principle of a gland, the whole weight and the tubing pressing the moss into a water tight joint. This method is very costly, costing about £150 per fathom.

JOHN HOLLAND,
14, Chapel Lane,
Galston, Ayrshire.

Question 6—What are Coal, Ganister, and Bituminious Shale ?

Answer to Question 6—

Coal is the decomposed remains of an extinct vegetation, which in some cases must have been dense and thick. It is found in beds or seams, and contains a large amount of carbon which renders it fit for fuel. It has been found in stages of formation as follows:—Peat Bog Coal, Bituminious and Anthracite. *Ganister* is the substance which is found below the coal bed and is understood to be the soil on which the vegetation grew, as it contains the fossilized remains of tree roots, etc. Ganister is extensively used for brickmaking, etc. *Bituminious Shale* is a stratum that contains a large amount of carbon and bitumen. It is very productive in oil for lighting purposes. Some persons suppose it to be the solidified state of coal owing to heat and pressure.

RICHARD CHEGWIN,
Howden-le-Wear,
Via Darlington.

Question 7—How can Galena and Zinc Blende be separated, and how is the process affected by Iron Pyrites in the Vein Stuff?

Answer to Question 7—

The ores of Galena and Blende can be separated by first breaking the mixed ores in a disintegrator, which is an apparatus for rapidly reducing metallic quartz or vein stuff to a size sufficiently small to be acted on by separating sieves. The ores are next sized by a trommel or cylindrical sieve, and after being sized they are passed on to a jigger, having two currents of water moving in an opposite direction so that the water buoys up the lighter material or gangue, while the heavier ores fall to the bottom according to their specific gravity. The process is affected by iron pyrites, as they will not be pounded so much as the Galena or Blende, according to their hardness, and before they will separate from the vein stuff they have to be further crushed by steel rollers, and then separated by the kieve or buddle, the iron pyrites falling or stratifying to the bottom of the kieve and the vein stuff on the top of it, when it can be scraped off and the pyrites set free.

WILLIAM ROBSON,
126, Church Street,
Walker-on-Tyne.

Question 8—What weight will break a beam of Memel Timber 6″ × 10″, resting on supports 10′ apart, load in the middle. The modulus of *rupture being* 10·386?

Answer to Question 8—

Breaking weight in cwts.—

$$= \frac{\text{Breadth} \times \text{Depth} \times \text{Modulus}}{\text{length in feet.}}$$

$$= \frac{10 \times 6 \times 6 \times 10{\cdot}386}{10} = 373{\cdot}896 \text{ cwts.}$$

breaking weight.

ANDREW HEPBURN,
5, Gladstone Street,
Burnbank,
Lanarkshire, Scotland.

Question 9—How many gallons of water per minute will an engine of 70 Indicated H.P. raise from a depth of 100 fathoms?

Answer to Question 9—

One H.P. is equal to 33,000lbs., being raised one foot high in one minute, and one gallon is 10lbs. in weight, so we get it thus—

$$\frac{33{,}000 \times 70}{100 \times 6 \times 10} = 385 \text{ gallons raised}$$

in one minute.

JOHN GRAY,
Oliver's Buildings, Glebe Row,
Bedlington,
Northumberland.

Question 10—When fire-damp is burnt with air explosively, what is the nature of the products of combustion?

Answer to Question 10—

If the combustion of the explosive mixture of fire-damp and air be complete the products will be carbon dioxide ($C\ O_2$) and water ($H_2\ O$). As, however, this complete combustion does not actually take place in the mine, we get an additional product, viz. :—Carbon monoxide ($C\ O$) resulting from the insufficiency of oxygen. A large quantity of nitrogen with small quantities of oxygen and marsh gas will also be found after the explosion, but as these are un-

changed they cannot be considered as products. Carbon monoxide is a clear, transparent, inflammable gas, a carbon and oxygen compound, and a deadly poison, 1 % will cause death. It is this gas which is the cause of the return fire after an explosion. The quantity of carbon monoxide produced increases as the supply of air during combustion decreases. Carbon dioxide or choke-damp, also a compound of carbon and oxygen, but in different quantities is not an inflammable gas nor will it allow burning to go on in it. It is one and a half times as heavy as air, and is often found at the bottom of wells in disused workings, &c. It is not poisonous, but its exclusion of oxygen causes suffocation. The small quantity of water produced by the explosion is owing to the high temperature involved, given off in the form of steam.

W. W. Valentine,
42, Chorley Road,
Blackrod,
Near Chorley,
Lancashire.

PRIZES.

SILVER MEDAL Competition.

As announced in our last number, we intend to offer Silver Medals for various competitions that will be announced from time to time.

The first one will be for the best series of SHORT articles on the following subjects:—

Sinking	Boring
Pumping	Timbering
Winding	Mechanics
Haulage (any system)	Ventilation
Methods of Working a Seam	

This will take more the form of a test in any or all the subjects, and one or all of the subjects can be attempted. Any formulæ or notes can be written, and we leave it solely to our readers as to the methods of describing—only the article must be as brief as possible—book-work will disqualify.

These Medals will form a handsome testimonial, and one of the best certificates of proficiency that it is possible to obtain.

All articles must be fastened together, and reach us not later than March 6th, 1893.

We intend to give a number of Questions that have been asked at Examinations for Managers, Under-Managers, and at the Science and Art Examinations, for which we shall give a uniform reward of 1/- for the best original answers, subject to the following conditions, which must be observed in all competitions:—

(1) To be written on one side of the paper only.
(2) The name and postal address must be attached to every answer.
(3) They must reach us by February 6th, 1893 (except "Silver Medal" competition).
(4) Write "Merit" on left-hand corner of envelope.

Question 1—Discuss some method of transferring power from a vertical water wheel to a shaft 150 yards distant?

Question 2—What H.P. would be required to haul 20 full tubs, each weighing $10\frac{1}{4}$ cwt., up an incline rising 1 in $3\frac{1}{2}$. Speed 200 yards per minute, friction of tubs $= \frac{1}{80}$ of weight, neglecting weight and friction of the rope?

Question 3—Describe the method of working the Staffordshire Seams of thick coal ?

Question 4—Give an account of the Northumberland and Durham Coalfield ?

Question 5—Sketch and describe, giving weights, etc., of a double-decked and three decked cage ?

Question 6—Describe any Drilling Machine ?

Question 7—Give the composition of Gunpowder, Dynamite, Roburite, and how do they differ as explosives ?

Question 8—Compare and discuss Ventilation as produced by Fans, Furnaces and Steam Jets ?

Question 9—To raise 700 tons per day of eight hours, depth of shaft 350 yards, what size of coupled winding engines would you put down ? Give size of cylinders, length of stroke, diameter of drum, number and class of boilers and working pressure of steam.

Question 10—Sketch the method of working coal known as Bord and Pillar ?

CORRESPONDENCE.

126, Church Street,
Walker-on-Tyne.

Dear Sir,

As I am a regular reader of your excellent Mining Journal, I must say, for my part, I think it suits Mining Students and all others engaged in Mining, much better than any other paper published for the same purpose. What do Mining Students want to know about the composition of Jam, Soap, etc. ? I am recommending your Journal to all my mining friends.

I beg to remain,

Yours truly,

WM. ROBSON.

To the Editor of "Mining."

(The foregoing and hundreds of others all tend to show that our work of bringing a reliable Journal "devoted to the interests of mining," is being appreciated."—Editor.)

A NEW COMPETITION.

To enable "Mining" to still become more widely known, we want every reader to take a sheet of lined paper, get everyone to whom they show this Journal to write their name and address on it, and to the reader who forwards the greatest number of names and addresses, we shall send 2/6. Send them on or before February 6th, 1893.

MORE PRIZES.

We will send "Mining" post free for six months to the reader who suggests the best method to improve this Journal. Mark envelopes "*Improvement.*"

TITLE PRIZE.

We offer 2/6 for the best title for this Journal. Mark envelopes "Title."

MISSING WORD COMPETITION.

The first letter containing the word "Aluminium" opened on December 26th, was sent by

R. STRACHAN,
Begg's Yard,
High Blantyre,

who will receive "Mining" post free for six months — the paragraph appeared in No. 2.

ANSWERS TO CORRESPONDENTS.

Talc. (Notts.)—Glad you like No. 2. We have forwarded Nos. 1 and 3 as requested. Thanks for the information.

Stallman (Yorks)—The mining bits you sent will be inserted; have forwarded to you posters, etc.

X. T. Z. (Bedminster).—The particulars you sent regarding the sad accident are too long for insertion—many thanks for well wishes.

Pitman (Durham).—Re ropes, we have some very concise and useful information on what you require, will insert as soon as we have space.

B. (Bamfurlong).—We were sorry such information ever appeared, but it is taken for what it is worth from such a Journal.

Underlooker (Bolton).—Sometime in January. Glad you like our Journal. The value is enormous.

Apprentice (Glasgow). — Our Journal should be in your hands every other Thursday morning.

Fireman (Hindley).—Your opinion is altogether too flattering—if we published your letter, what price libel.

A. P. B.—If it will not work, add a little more sal-ammoniac.

Friend (Tow Law).—The rule is by no means easy. You were a trifle out, try the following—$\frac{PD}{55000} \div \cdot 03$.

Pit Agent.—You must order at least two days before the day of publication. Cash in every case with order.

PRIZE ESSAY.

We have awarded the prize of 5s. to

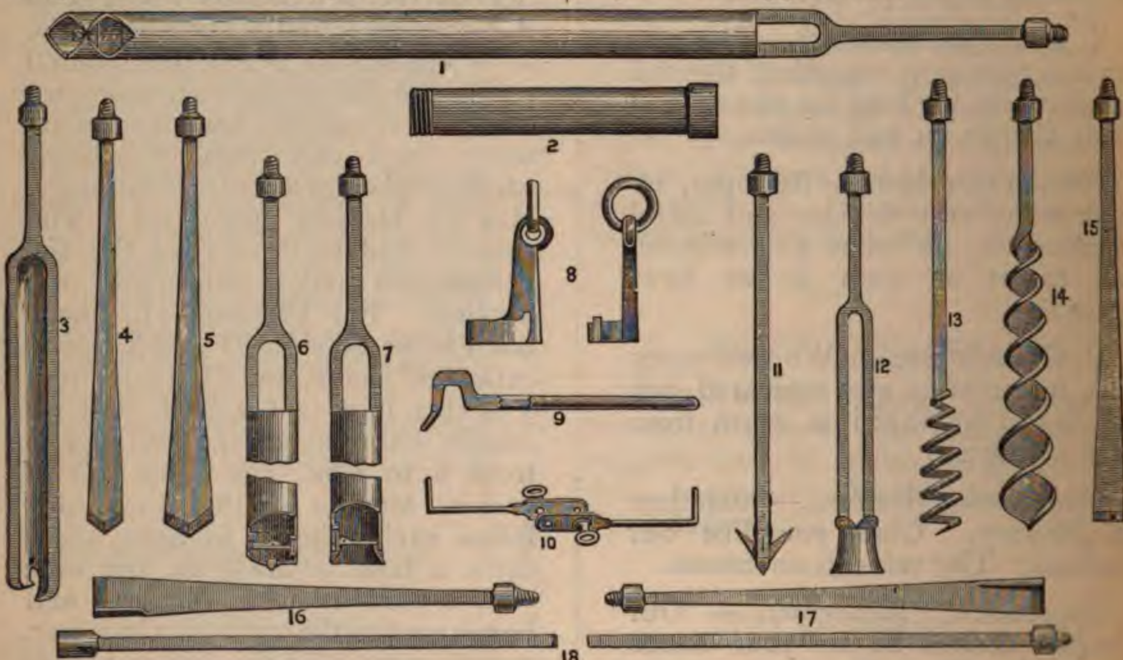
JOHN GRAY,
Oliver's Buildings, Glebe Row,
Bedlington,
Northumberland,

for his Essay on Boring and Sinking.

BORING.

BORING is a means resorted to under various circumstances. It is applied to prove the mineral and dip of the strata of an unknown coalfield, to prove a fault, to run off water from one seam to another when advancing towards old workings, and for blasting operations. The process and tools vary as the circumstances under which they are applied. For Blasting.—In single hand holes, steel drills and jumpers, octagonal shape, and a hammer from 3 to 4lbs. in weight is used, and for double hand holes the hammer is from 6 to 8lbs., the drills are of various lengths so that they may follow each other. In using these drills a hole is made in the rock with a pick to enter the drill and hammered on the end with a hammer, and at every blow the drill is turned a little according to the diameter of the hole and nature of the rock, but the above tools are very seldom used except in very hard stone and sinking, there being rotating machines to do the work much quicker; the machine drills are of an auger shape and propelled by being connected to a screw.—(*Illustration in our next*). The rotating machines are also used for boring against old workings. In boring against old workings according to Rule 13 in the General Rules of the C. M. R. A., 1887, "no working shall be driven more than 8 feet

wide, that is, within 40 yards of the old workings, and a bore hole from the centre of the place must be always kept 5 yards in advance, and sufficient flank holes bored on each side." For vertical holes of great depth, there are many different kinds of boring. In commencing to bore, a staple is sunk through the boulder clay to the stone head, this will enable the borers to get off a longer length of rod when they are drawing them, and will not cost as much as the last few fathoms bored. A scaffold is erected about 30 inches high, and a metal pipe the same size as the chisel and about 3 feet long, is passed through the scaffold with its flange 2 inches above the scaffold, the pipe is truly plumed to get it perpendicular and then wedged. It must be plumed with a piece of brass (not iron) suspended by a piece of copper wire.



1. Shoe nose shell with valve for bringing up loose stuff.
2. Wrought iron screwed well bore pipes.
3. Auger for clay and stiff soil.
4. 5. } V Nose chisels for hard ground.
6. Shell auger with valve for loose and wet soil.
7. Bell shell with valve for loose gravel.
8. Lifting dog for raising rods.
9. Pair of rod wrenches for screwing and unscrewing rods.
10. Levers for turning rods.
11. Spring dart for drawing pipes in bore holes.
12. Bell box for bringing up broken bits.
13. Spiral worm for extricating broken rods.
14. Worm auger for looseuing stuff in bore holes.
15. Square nose chisel.
16. ⊊ nose chisel for hard strata.
17. T nose chisel for hard strata.
18. Rods with screw joints in 5 and 10 feet lengths.

(To be continued).

MINING DUST.

The creosoting method of preserving timber was invented in 1836, *by Breant.*

The dye produced from one ton of Lancashire coal, will produce dye enough to dye 375 square yards of flannel.

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MINING

A Journal devoted to the interests of Mining.

No. 6. Vol. I. FBBRUARY 9TH, 1893. FORTNIGHTLY ONE PENNY.

PRIZE ESSAY.

PART SECOND.

BORING.

We must provide the necessary tools, &c., which are as follows:—(1st) The head-gear for lifting, raising and lowering the rods, either the shearlegs and jack roll, or windlass, rope, lifting dog, lifters, lever and chain, brace-head and spur wheel. (2nd) The chisels are the cow-mouth, diamond, tec, square mouth, star, and the bull for rounding the hole. The chisels are made of the best Swedish iron, layed with steel; they are about 15″ long, having a male screw to connect them to the rods, with ⅛th of an inch pitch. (3rd) The rods they vary in lengths from 1′ to 18′, the short rods only used for convenience, they are 1″ square and swell at the joints, they are made of the best Swedish iron with a male screw at one end and a female screw at the other. (4th) For cleaning the hole the sludger and wimble is used, the sludger is 3′ long and upwards (cylindrical) with a slot at the top and a valve at the bottom, opening inwards; the wimble is the same length and form, open on one side, with a shell auger bottom, used for extracting the clay material. (5th) For changing the rod and breaking the joints the hanging keys and shifting keys are used. (6th) The tools for extracting broken rods are the béche or bell box, crows foot and the spiral worm. (7th) The perpendicularity of the hole is tested by the Clinostat. (8th) Tubes for tubbing the hole. (9th) Tools for taking out the tubbing. Boring by hand, two men can bore about 11 fathoms, and with the aid of a lever they may bore 5 or 6 fathoms without the assistance of a third man at the lever. The lever is a pole made of pine about 10′ long and 4 or 5″ square, and works on a fulcrum 2′ from one end, the end is arched, having a chain, lifting dog and a regulating screw attached. The object of the arched end and regulating screw is to have the lever always horizontal, that the rod may be lifted perpendicular, but if the hole should ever deviate from the vertical the Clinostat is used, it consists of a clear glass tube, containing gelatine liquid, into it is placed a magnetic needle, the glass tube is placed in a brass tube and lowered down the hole by means of a cord every 100′, the gelatine will solidify as it cools, and the angle at the surface of it will represent the deviation from the vertical, while the magnetic needle will point the direction; the needle is supported in the liquid by means of a float and a very fine cord being attached to it. The brace-head is the handle by which the rod is lifted while boring. The shearlegs and jack roll, or windlass, is used for raising and lowering

HEAD-GEAR FOR SINKING

Shewing Arrangements for Winding, Pumping, &c.

the rod when changing the chisel or cleaning the hole; the brace-head is taken off and the lifting dog which is attached to the end of the rope put over, the rods and a lifter screwed on and the rods raised or lowered when the hole is very deep; the most of the time is taken up with cleaning the hole, but a good deal of time may be saved by having a good reliable rope attached to the sludger. When the strain is very great on the rods they sometimes break at the joints, and to take out the broken pieces, the bell box, craw-foot or spiral worm is allowed to fall on the broken pieces and then brought to the surface; In passing through running ground tubing is used, they are screwed together or made to fit one within the other, the hole is required to be started very large at the commencement, and when finished, the tubes are withdrawn by the spring dart; to prevent the strain on the rods or them lashing against the side of the hole, Eynhansen sliding joint meets this requirement, it consists of a number of chisels fitted into a frame, the frame is made to work in a cylinder, so that when the chisels strike the rod, the rod falls a little by the cylinder passing down the frame. Kind's free falling cutter is also a method to take the strain off the rods, the cutting tool is the same as the one used in the sliding joint, the cutter works within a frame having movable joints, at the bottom of the frame are a pair of jaws, which close when the upward stroke is made (by the pressure of the water on the top of the frame) lifting the cutter, when the downward stroke is made the pressure is on the under side of the frame which opens the jaws and the cutter falls. In Mather and Platt's method, a flat rope is made fast and wound round a drum, at the other end of the rope is an automatic arrangement to cause the cutting tool to turn round a little at each stroke, the cutting tool is made up of a number of chisels; a steam cylinder is underneath the axle of the pulley over which passes the rope, the axle rests on the top of the piston rod, the steam passes into the bottom of the cylinder, which lifts the piston pulley and cutter; when the steam is released the pulley, rope, and cutter falls; the rope is also used for lowering and raising the pump for extracting the debris; there are guides connected to the cutter to prevent the hole from deviating from the vertical. Beaumont's diamond cutter consists of a steel ring or crown, set with diamonds, the rods are hollow steel tubes, water passes down the inside carrying the dust in suspense on the outside of the tubes, and the core passes up the inside; the core is extracted by a tube passing within another tube with vertical slits, and in those slits are loosely placed wedges at the surface, and when the tube is at the bottom of the hole a sharp blow on the top of the tubes will tighten the wedges, and if the tubes are twisted sharply the core breaks and can be drawn to the surface, this affords a correct section of the strata. The rods are rotated by an arrangement of bevelled wheels, and the downward pressure is by compressed air acting on a piston within a cylinder directly above the hole. The Beart and Fanvelle method consists of hollow rods, but cannot be applied successfully except in holes of moderate depth. In the Chinese method, iron rods are *not* used, the chisel is attached to the end of a rope or one or two lengths of rod to keep the

hole straight; this method for deep boring is impracticable. No one rule can be given for the cost of boring; the rule is for some holes a price per fathom, for the first 5 fathoms and increasing a definite sum per fathom at the end of every 5 fathoms (and sometimes it is in feet), to get the total cost, add the cost of the last fathom to the cost of the first, and multiply by half the depth; the cost of the last fathom is got by multiplying the cost of the first by the number of times the advance is made, and then add the cost of the first, which will equal the cost of the last fathom.

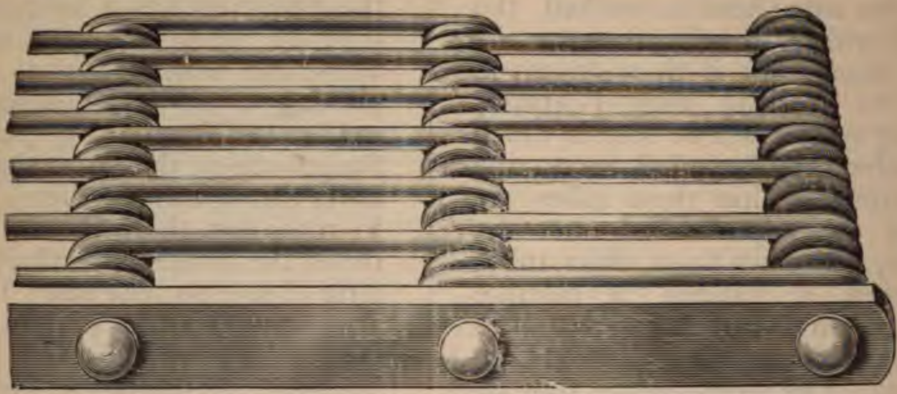
SINKING.

AFTER the trial boring—the size, form, and the method of sinking will have been decided on, also the tools and materials, &c., necessary for the sinking will have been prepared; if it is fair ordinary ground, the shaft will be commenced 2′ or 3′ larger than the intended finished size, and if two shafts are required they must not according to the C.M.R.A., be nearer than 15 yards to each other, and as soon as the stone head is reached the sides must be lined to comply with the Act. A bed is made on the stone head and must be level, and tarred flannel laid on the bed, a round of oak crib is laid on the bed, and another round of crib 3′ above the other supported on punch props, being set on the former crib; crib after crib is laid the same way, until the last one is about 3′ above the surface; backing deals are placed behind the cribs around the shaft, and stringing deals are nailed to the cribs on the inside, and the whole is hung by the stringing being nailed to buntons at the top of the shaft; the sinking is started again in the stone on the inside of the cribs, leaving part rock in to support them, and the shaft again opened out to the size; the rock will have to be blasted, taking care to have all the hole pointing to the centre of the shaft, and sides to be hewed or wedged back; it will be well to fire the shots by electricity, so that a good many shots can be fired together—it will be safer, saving time, and a greater blasting force will be acquired; when the sides are considered unsafe they must be walled, a bed is prepared as in the former case, and a cast-iron walling crib is laid, and a brick or stone walling built off the crib, taking care to break every joint and build in iron ring water cribs for collecting the water running down the sides of the shaft; if the shaft is making very much water, a set of pumps will be needed, a lifting set will be best as it takes up less room in the shaft, the set is supported by ground spears attached to a ground rope on the ground crab for raising and lowering the set, also by Bunton's set inside of the shaft, and it may be best to tub the shaft instead of walling, if so, a wedging crib is laid as in the preceding case, and segments of iron tubbing is built off the crib, taking care to break the joints and to have oak sheeting between every contact surface, and at the end of every 10 fathoms put a new wedging crib in, and when there is sufficient weight of tubbing the joints are wedged with oak wedges as long as one will drive and the holes pluged up except a few for pass pipes for reducing the pressure of water at the back; if the ground is soft or running ground, it will have to be *piled* by deals, pointed and shod with iron, being driven into the ground; the shaft will require to be commenced very larg according

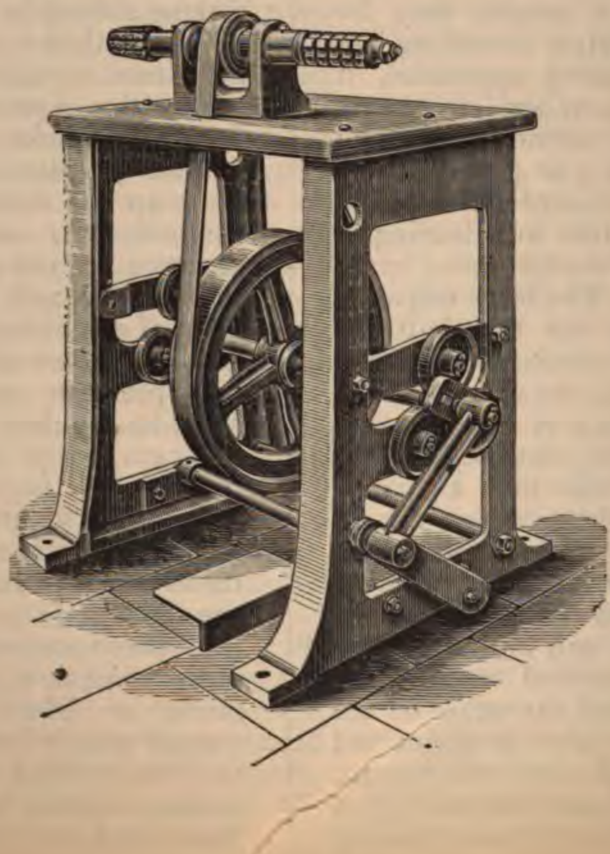
to the depth of the running ground to go through, the piles are supported by oak cribs which are placed very near to each other, laying them level, and as the sinking advances, and when the stone head is reached, the shaft is walled or tubbed as in the other cases, but if there is much water to contend with Poetsch's freezing system will be best, in which iron tubes are forced down to the hard stone, within those tubes are smaller tubes perforated near the bottom, and down those inner tubes is forced a solution of calcium chloride, which has been cooled 40 degrees below freezing point O° Centigrade. The operation is kept up until the whole area is frozen and then sinking commences as in the ordinary way, and when the stone is come to tubbing or walling is put in according to circumstances. Where the stone is very hard and much water, Chaudron and Kind's system may be adapted; this system is nothing less than a large boring apparatus, it consists of a number of cutters jointed together termed a trepan; the first boring is 3 or 4' in diameter and kept 30' in advance of the second boring, and the tool for cleaning is like the ordinary sludger being larger with two valves. The large trepan is intended to cut out the shaft the required size, it consists of a large number of chisels, the chisels on the inside of the trepan is much longer than those on the outside, so that the debris will fall into a bucket placed in the first cutting for its reception, the rods are actuated by a long beam about 24' long, working on a fulcrum near one end, the rods attached to one end and the other end being connected to a steam engine; to prevent the strain on the rods a sliding joint is connected between the rods and the trapan, they are raised and lowered by a steam engine; when the water bearing stratum is got through the cutters are set in a horizontal plane for the purpose of shearing back the sides for a tubbing bed, the tubbing is made of cast-iron rings about 5' high, the first ring has a bottom with a pipe up through it with a cock to allow the water to pass into the tubbing to aid in its descent, they are lowered by rods and screws, the flanges are on the inside, having bolt holes through them, they are put on from the top, there is a groove run round the flange, into which is put a strip of lead so that when the joints are bolted tight the lead is squeezed until the screws can go no further. To make the tubbing water-tight at its head the lower ring slides inside the other, and is surrounded on the outside with moss, which is tightly rammed in between the space of the two outside flanges, this being done the water is pumped out and the sinking started in the ordinary way. Triger method is to divide the shaft into two air-tight compartments, each with a door opening downward each with a safety valve, and on the bottom partition is a jack roll to draw up the debris from the lower compartment, and through each partition are two pipes, one for compressed air and the other for the relief of any water that may accumulate, the valves relieve the air so that the pressure can be regulated according to the depth, the water in this case is kept back by the great pressure of the air which may be 30lbs. per square inch. To keep the shaft perpendicular, also the tubbing, a bunton is placed across the shaft and through the centre of the bunton, representing the centre of the shaft is a hole, a plumb-bob made of brass suspended by a copper wire is hung in the centre of the hole and a piece of deal, the radius of shaft is carried from the line round the shaft.

MINING APPLIANCES.

BELOW we give an illustration of an improved Screen for cleaning coal—



And also a machine for cleaning lamps—which is a great improvement on hand labour. They are manufactured by Johnson, Clapham and Morris, of Manchester. In our next article we shall give an important improvement for cleaning lamps by machinery.



ꞩWERS TO QUESTIONS.

stion 1.—How many gallons of a minute will an engine of dicated H.P. raise from 150 ns ?

to Question 1—

: H = Horse-power of engine.
F = Depth of pit in fathoms.
G = Quantity of water in gallons per minute.

$\frac{H \times 550}{F} = \frac{80 \times 550}{150} = 293{\cdot}3$ gallons minute.

GEO. JOHNSTONE,
Beacon Hill Cottages,
Nr. Gateshead-on-Tyne,
Co. Durham.

:stion 2.—How long will it take ir current of 30,000 cubic feet ıinute to make a circuit of an y 12′ high and 8′ wide, and yards long ?

to Question 2—

.ocity in feet per minute = $\frac{}{y} = \frac{30000}{96} = 312{\cdot}5$.

·tal time in minutes = $\frac{\text{l distance in ft.}}{\text{· per minute in ft.}} = \frac{3500 \times 3}{312{\cdot}5} = 33{\cdot}6$

WM. M. KILPATRICK,
24, Baillie's Causeway,
Hamilton, N.B.

:stion 3.—Describe a Longwall od of working a seam with a dip ?

· to Question 3—

the rearing seams of Midın which dip into the earth at :s varying from 20 to 90 degrees, customary to drive the slopes :lines to a certain depth, then :h levels off in a horizontal line ıch side, and with a heading n to the rise, open up the field, keeping the line of faces at an angle of 45° from the horizon. It will be obvious as the coal is thus being worked away, horizontal roads will have to be broken off both sides of the incline at distances apart of 12 to 16 yards. The roadways are secured overhead with timber upon which the debris of the seams rest and are so arranged that the coal always runs down to the miner, thus facilitating the loading operation. It will be seen by this method that the deeper portions of the incline as it passes through the goaf will be somewhat difficult to maintain, so that the above method is generally somewhat qualified. In most instances a certain seam—not to be worked meantime—is selected, and the main incline sunk in that. When the first openings are to be made, levels are driven to each side as before, for say 50 yards. Then cross measure tunnels are driven—just like a pit in horizontal elevation, till the seam overhead is struck. Levels are then started to meet over the main incline and the seam opened up as before with this exception—that the places are driven to the rise to a distance of only 50 yards, the coals being all run through shoots carried through the goaf to recesses off the level road and filled there. By this method, new stages are always being opened up, the main incline continuing to be sunk the while.

WM. M. KILPATRICK,
24, Baillie's Causeway,
Hamilton, N.B.

Question 4.—How would a volume of 150,000 cubic feet of air and gas be affected if the barometer fell from 31 inches to 29 inches ?

Answer to Question 4—

According to Boyle's law, "*as the pressure increases the volume reduces, and as the pressure reduces the volume increases*"; this is only true when the temperatures remain the same; therefore, in this case, the volume will be in the inverse ratio to the pressures. The volume will be found as follows:—thus: $\frac{150,000 \times 31}{29} = 160,344\cdot8$ cubic feet of air and gas.

Now the volume will be increased from 150,000 cubic feet to 160,344·8 cubic feet, if we now subtract 150,000 from 160,344·8, we get the amount the volume has increased. Thus: $160,344\cdot8 - 150,000 = 10,344\cdot8$ cubic feet.

AUGUS McLELLAN,
99, Knightswood,
Maryhill,
Glasgow.

Question 5.—Describe in detail and compare with sketches the Stephenson, Clanney, and Muesler Safety Lamps.

Answer to Question 5—

Figure 1.

Fig. 1—Is the Stephenson
or Geordie. The light is surrou
by a wire gauze cylinder with a
cylinder inside, covered wi
copper perforated cap. A rin
and bottom is supported by
and has a movable cover to pr
the hand, and top of the g
fastened down by a button to
top ring, a ring is attached to
cover for carrying and a rail to
it by; the bottom ring is s
threaded for the reception of a
can. A picker passes up thro
tube in the oil can to trim the
without taking the can off,
ventilated by perforations below
light, the products of combu
passes through the glass, perfo
cop and top of the gauze.

Figure 2.

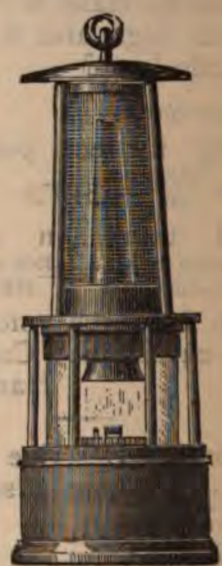


Fig. 2—Muesler lamp consists
glass cylinder in the lower part,
a wire gauze on the upper part,
inside of the gauze is a co
chimney attached to a perfo
diaphragm, this lamp has been
proved recently by a bonnet, g
it the appearance of a Mar

Figure 3.

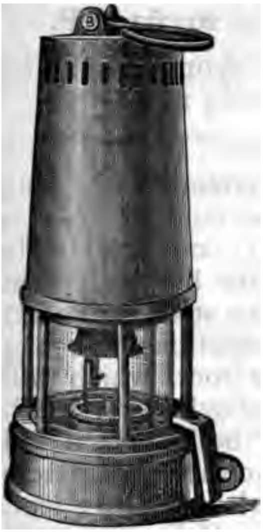


Figure 4.

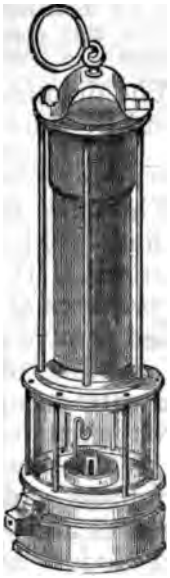


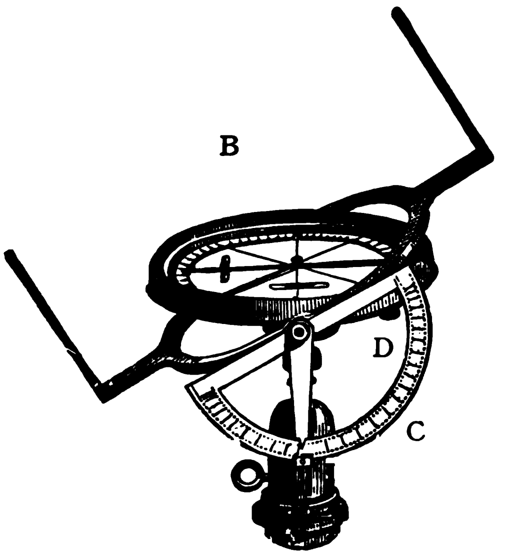
Fig. 3—Clanney lamp, this like the Muesler has a glass cylinder around the light with a wire gauze cylinder above, and a wire gauze cap over the top of the gauze cylinder. Both the Muesler and the Clanney, like the Stephenson lamp, has an oil can, pricker, cover with a ring, and nail attached, the oil can in each case is made fast to the lower ring by a lock. The safety of the safety lamp is due to the conductibility of the gauze, which has 784 apertures to the square inch, the gauze conducts away the heat from the flame as it passes through the apertures, and is cooled below the point of ignition before it reaches the gas on the outside; their safety also depends on the velocity of the current, the Stephenson is unsafe at a velocity of 12 feet per second, the Muesler at 20 feet per second, with a bonnet 46 feet per second, and the Clanney is unsafe at 8 feet per second. The difference in the velocities at which they fire is due to the way they are ventilated. The Stephenson lamp is made now for the feed air to enter by perforations in the bottom ring, through the gauze, then through below the glass. In the Muesler it enters through the gauze and through the perforations in the diaphragm above the glass, and passes out by the chimney, which is covered by a perforated cap. In the Clanney it enters through the gauze above the glass.

JOHN GRAY,
Oliver's Buildings, Glebe Row,
Bedlington,
Northumberland.

Question 6.—Describe how you would make a survey with a common miners' dial.

Answer to Question 6—

Let A per sketch be the shaft, from the centre of which it is desired to make a survey to the point F. I would fix the dial at B and first of all level it. The north point of dial should be first in the direction it was intended to proceed. When level of dial is found, unclamp the lower plate, keeping the upper one clamped, and take a sight from B to A. When the needle has settled read off the bearing and enter in survey book, beginning at bottom of leaf and going upwards. Next measure from B to A, and enter it immediately above the bearing, thus 380 (links) N 45½ W. Next take a sight from B to C without removing the dial except to move round the unclamped plate to get the sight at C.



When the bearing is obtained and the length measured, enter as before, placing numbers or letters to each shot; then take up dial and fix at point D, level it, and proceed as before. Care should be exercised that no iron of any kind is near the dial whenever fixed, or the needle will be attracted and the survey rendered inaccurate. The above is a loose needle survey.

George Rhodes,
High Moor,
Killamarsh,
Rotherham.

Question 7.—What power and appliances would you consider necessary for drawing 600 tons of coal in ten hours from a depth of 400 yards (give some of the leading dimensions of plant — engines, boilers, etc.—that you would prefer).

Answer to Question 7—

First we must find the H.P. of the engine necessary to do the work. The rule is as follows—multiply the weights in lbs. by the distance it has to be raised through in feet and divide by 33,000 × by time in minutes and by a modulus of ·4 thus:—

$$\frac{600 \times 2240 \times 400 \times 3}{33000 \times 10 \times 60 \times \cdot 4} = 203\cdot 63 \text{ H.P.}$$

The diameter of cylinders may be found by the following rule:—

$$\frac{203\cdot 63 \times 33000}{30 \times 5 \times 2 \times 35 \times \cdot 7854} = \sqrt{814} = 28\cdot 5$$

Therefore the diameters are 28·5 inches. The meaning of this is multiply H.P. by 33,000 and divide by pressure of steam by the piston speed (I have given a stroke of 5 feet) by number of revolutions × ·7854 and extract square root, which will give the diameter of cylinders. H.P. of a double-flue boiler is found as follows—add the three diameters together and × by length all in feet, and divide by 8 = H.P. We will take a Lancashire boiler, 7 feet in diameter, diameter of flues 2·5, length 30 = 45 H.P., divide H.P. of engine by this— = 5 boilers, allowing one to be off at a time. To find the size of rope required to draw the above weight in ten hours—600 tons in ten hours = 60 tons per hour and allowing two minutes per run, including the loading of the cages, the number of runs per hour will be $\frac{60}{2}$ = 30, and each run = 2 tons of coal drawn. The weight of four tubs each holding 10 cwt., will be 2 ton, and allowing for cage and chains, 2 tons. The total load suspended on the end of the rope will be 5 tons. The safety load of a 1″ rope will be $\frac{1 \times 1}{3}$ ⅓ of a ton or 746 lbs., and the weight of a rope of 1″ girth and 200 fathoms long will be 1 × 1 × 200 × ·9 = 180lbs. = 746—180 = 566lbs. Therefore a 1″ rope will safely carry 266lbs., after deducting its own weight. The number of lbs. in 5 tons = 5 × 2240 = 11200, and dividing this by 556 and extracting the square root will give the circumference of rope—

$\frac{11200}{566} = \sqrt{19 \cdot 7} = 4 \cdot 4$ inches.

To sum up it will require a set of double horizontal engines, (these are generally preferred now) of 203·63 horse power.

Diameter of cylinders, 28½ inches.

Length of stroke, 5 feet.

Pressure of steam, 30lbs. per square inch.

Boilers—Lancashire double-flue, 7′ × 30′ and flues 2·5 each, this will require four working and one off.

Circumference of rope, 4·4 inches.

G. W. Scougall.
Bell's Place,
Bedlington,
Northumberland.

Question 8.—You have a straight main road, 1,500 yards long, regular gradient of 1 in 50 falling from the shaft, up which a large quantity of coal has to be brought, what arrangement would you adopt and what provisions of the C.M.R.A. would you have to observe?

Answer to Question 8—

I would adopt the endless rope system of haulage, and to prevent the jockies from slipping, I would use a hunch rope. I would observe Rule 14 in having proper means of communicating distinct and definite signals between the stopping places and the ends of the plane, and if used for travelling have sufficient man-holes or places of refuge not more than 20 yards apart; also Rule 16—in keeping every man-hole and every place of refuge constantly clean, and not to allow any person to place anything in such places of refuge or man-holes. Rule 21—I would see that the roof and sides were properly secured and not to allow any person to pass that way if unsafe, unless appointed for the purpose of exploring or repairing. Rule 31—I would have all wheels and other dangerous parts of machinery securely fenced. Rule 5—I would appoint a competent person or persons to examine all machinery and rope, also every other appliance in use both above and below ground every 24 hours, and have the result of every such examination entered in a book kept in the mine for that purpose.

John Gray,
Oliver's Buildings, Glebe Row,
Bedlington,
Northumberland.

Question 9.—"TIMBERING."—Discuss the relative merits of (*a*) Steel Girders; (*b*) Iron Girders; (*c*) Larch Timber; (*d*) Norway Timber, for "barring" purposes.

Answer to Question 9—

(*a*) Steel girders compared to iron girders are much stronger, that is bulk for bulk, and in this case steel girders need not be so large, so as to bear the same weight as iron girders; one great drawback to steel girders is that under a sudden pressure they are liable to break, whereas with iron girders they will bend before they break down, and if in case they do get bent down, they can be taken out and put in on the reverse way. Larch timber is very suitable for mines where iron girders are not in use, and this timber, though expensive, will last a long time, for I have seen props in an old mine which have been standing for 20 years or more, and which, though the atmosphere was damp and unfavourable, they were just as solid and good as new. Norway timber is cheaper than all the others and suits very well were it has not to stand for any length of time, and

suits very well for bord and pillar workings were the bords are drawn out. This timber will not bear any great weights and is very suitable for shallow seams.

WILLIAM ROBSON,
126, Church Street,
Walker-on-Tyne.

Question 10. — How are ores cleaned from waste materials ?

Answer to Question 10—

No universal process of separation can be adopted, but the process will greatly depend upon the condition and nature of the ore or vein stuff to be treated. Hand picking is first resorted to. Copper, lead, and zinc ores are hand picked and then broken by Blake's stone crusher, afterwards it is passed through steel rollers and then passed on to the jigging machine, after which the ore can be separated from the gangue. Tin and Gold are pulverised by heavy stamps, and are then separated by the buddle or frue banner. When tin is associated with pyrites, calcining or roasting is resorted to. Gold is sometimes finally passed over amalgamated copper plates. In nearly all these processes the specific gravity of the materials are taken advantage of.

THOMAS BEST,
Railway Street, Tow Law,
Co. Durham.

ANSWERS TO CORRESPONDENTS.

G. R. A.—We will consider your suggestion.

Reader.—And others *re* Silver Medal Competition, any length of articles may be sent.

Prop.—"Mining" will introduce several new and novel features shortly. Glad you like our Journal so much.

Northerner.—Sorry you do not agree with us in our decision.—Try again.

G. A. S. (Bury).—It is known as Carbon Dioxide chemical formulæ CO_2

Science.—Yes, it has changed hands. 2—No, it has no connection with us.

Silver M.—Do not be afraid to compete, we have lengthened the time.

TO OUR READERS.

Several Articles have unavoidably been crowded out in this number, but will appear in our next.

We hope all our readers will try to further our interests by showing "Mining" to their friends.

"Mining" is the only Penny Illustrated Mining Journal in the world, and we must have a large circulation to keep the quality of the matter contained in it up; we are making arrangements for several new features being introduced shortly.

MINING DUST.

Many colliers of South Wales who have only been able to work two days a week, are now working full time.

***

The commencement of what will be the longest tunnel in the world has begun, being when completed 12½ miles long.

Printed and Published for the Proprietor by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

MINING

A Journal devoted to the interests of Mining.

No. 7. Vol. I. FEBRUARY 23RD, 1893. FORTNIGHTLY ONE PENNY.

MINING NEWS IN GENERAL.

This page we hope to make one of the most popular features of this Journal having appointed correspondents in the principal mining districts, so that our readers will be acquainted with what is going on outside of their own sphere.

*** *** ***

Dr. J. E. Taylor, F.G.S., expresses his opinion, that coal may be found in Norfolk and Suffolk. Boring operations have been carried on lately near Bury St. Edmunds, to the depth of over 1,100′. The coal if found will be contorted as in the Belgium coalfield.

*** *** ***

We are pleased to know that such an able man and writer as Mr. C. M. Percy, F.G.S., M.E., has undertaken the editorial management of the "Science and Art of Mining," and we trust that it may be a success, of which there is little doubt.

*** *** ***

Several of the Students of the Wigan School of Mines, availed themselves of the opportunity of a visit to Owens College, Manchester. After having been through the Geological Museum—(where the many cases of specimens were explained by Mr. Winstanley, Teacher of Mining and Geology at the Wigan School of Mines), a most instructive address was given to the Students by Professor Boyd-Dawkins, on "The advantages of a knowledge of Geology in mining operations"—altogether this visit was most interesting and instructive, and we are sure that Mr. Winstanley's efforts met with the thanks of all present.

*** *** ***

The Malago Vale miners have agreed to resume work again, after being out on strike for upwards of eighteen months, pending the consideration of the matters in dispute.

*** *** ***

The Scotch coal trade shows no signs of brightening up, being no doubt due to several of the Danish and Swedish ports being closed through the Baltic still being frozen over.

*** *** ***

Mr. S. Woods, M.P., asked the Home Secretary on Tuesday, February 7th, whether he issued an order on December 24th, 1892, certifying that the following processes were dangerous to health:—The manufacture of explosives containing di-nitro-benzole (including Ammonite, Roburite, Bellite, etc.) these explosives are frequently used in coal mines in Lancashire, where the ventilation is not sufficient to carry the noxious fumes away, the men in many cases being slowly poisoned.

An ADDRESS by Mr. C. M. PERCY.

MECHANICAL VENTILATION.—*contd.*

WATER, air and steam travelling in pipes have an objection to passing round a curve, and any such diversion causes loss of effect. An ordinary conveyance travelling at a curve may capsize. A railway train running at a high speed would leave the metals if the outer rail of the curve was not elevated. So with the colliery ventilating fan. The inlet was connected only with the upcast shaft, the outlet with the open air. The fan was always full of air, and when put in motion the plates propelled the air, which, instead of as might be thought revolving in circles and churning itself, made its way, as nearly as was attainable, in straight lines to the circumference. Other air rushed in to fill up the vacancy within the fan, and so the current was maintained.

PRINCIPLES OF CORRECT FAN CONSTRUCTION.

There were two particular points to be aimed at in the construction of a colliery ventilating fan. First, the air should be able to get into the fan easily and to get out in as direct a line as possible. Second, the delivery of the air from the fan should be easy, otherwise it would meet resistance proportionate to its velocity, just as railway trains does. If they took a circular plate or board and caused it to rotate upon its centre, and whilst rotating drew a pencil or a chalk from the centre to the circumference, they would find that the line traced would not be a straight line, but would be *a curved line,* curving backwards *and passing easily into* the circle of the circumference. Such a curve would give the proper form of blades for these particular velocities, and all the modern fans were constructed more or less upon those lines. To ease the delivery of the air from the fan it was discharged into a chimney of gradually increasing area, making the velocity of exit as low as possible.

LARGE AND SMALL FANS.

At one time there seemed to be a rage for fans of large dimensions, as much as 50′ in diameter, requiring cumbersome and costly structures in themselves and extensive and costly foundations and buildings; but a change was being brought about, and it was recognised that the same purpose as to quantity would be served with a small fan as with a large one, provided the velocity of the circumference was maintained. These small fans revolve much more quickly, were less cumbersome, less costly, and necessitated less elaborate and less extensive foundations and buildings.

PRESSURE AND EXHAUSTING FANS.

There is probably no good reason why fans should not blow the air into the downcast instead of exhausting it from the upcast. They do in some cases, and, as a matter of fact, exhausting fans have been converted into pressure fans and *vice versa.* But generally the exhausting principle is adopted, and it produces less strain upon the fan itself than if worked on the pressure principle.

ADVANTAGES OF MECHANICAL VENTILATION.

It may be said that the advantages of the fan for colliery ventilation are—first, the current of air that can be produced is practically unlimited.

Second, there are scarcely any parts that can get out of order. Third, it can be used with absolute uniformity. Fourth, the speed, and consequently the current, can be increased or decreased at will. Fifth, there is no danger of fire in the mine, no injury to the shaft, and no nuisance to the surroundings of the colliery at the surface. Sixth, in the event of an explosion the fan receives no injury.

Horse Power of Ventilation.

References had been made to horse-power of a fan, by which was meant the horse-power of the ventilation which that fan produced, and it might be well to show how the horse-power was ascertained. First of all, then, what is meant by horse-power? It is simply a certain amount of mechanical work which is called a horse-power, and is really more than a horse can do, namely—raising 33,000lbs. one foot high in a minute, or the overcoming an amount of resistance equal to that. We measure the area of the fan drift, which is the main outlet for the air, in square feet. We measure the velocity of the air in feet per minute by means of the useful instrument known as the anemometer; we multiply these together and thus get the quantity of air in cubic feet per minute; we multiply again by the water guage in inches and again by 5·2 or $5\frac{1}{5}$, divide by 33,000 and we have the horse-power of ventilation.

What is Water Gauge?

That is all very well, but what is the water gauge and what is 5·2? It has already been explained that to produce ventilation by a furnace we rarify the air by heat, and to produce ventilation by a fan we rarify the air by exhaustion, in both cases reducing the weight of the column of air in the upcast shaft, the amount of that difference determines the current, and the difference is ascertained by the water gauge. But again we have to ask what is the water gauge? It is a bent glass tube open at each end.

(To be continued).

APPLIED MECHANICS RELATING TO MINING.

Chapter III.

ONE of the peculiarities of the Guibal Fan is the backward curvature of the blades, but this only seems to be following the working of the most approved description of the centrifugal pump. Another point is, the narrowing of the blades of the fan towards the circumference, so as to give a uniform area of air passages. There has been and is a great difference of opinion as to the best shape for the casing in which the fan revolves. M. Guibal, the constructor of this fan, at first, was very unsatisfactory in his results from the spiral casing, but Mr. Cowper, another authority, in an extensive series of experiments made with fans, obtained exceedingly satisfactory results, but Cowper's fan differed from Guibal's, because it had *straight* radial blades, and therefore under proper condition, Guibal ought to have obtained at least equal results. Another improvement is having an expanding chimney. At first the casing was closed all round the fan except at one place where the air escaped. Through the air coming out with such a high velocity, an arrangement has been introduced by which the air enters an expanding chimney. An adjustable shutter has been added to regulate the size of outlet according to the various volumes of air

required, and resistance to be overcome. Without either expanding chimney or shutter, it was found by experiment that the percentage of useful effect of the Guibal Fan was 31% with the chimney 57%, and with the shutter as well it rose to 61%. The percentage of *useful effect* means the ratio compared with 100 of the practical work of a machine compared with the work which ought to be done theoretically. With regard to the shaft upon which the fan revolves, and in connexion with the difficulty which is experienced in getting shafts of any great size, sound all through, it has been found the hollow shaft made from Whitworth compressed steel give very good results, and they will, no doubt, very soon come into far more general use than they are at present.

(*To be continued.*)

THE EARTH'S CONSUMPTION OF COAL.

By "Retso."

THE principal uses to which coal is put are:—

1st—Heating boilers of engines.
2nd—The generation of gas.
3rd—Smelting of metal.
4th—Domestic purposes.

At the present time there are at work about 900,000 steam boilers, equalling about 11,000,000 H.P. Half of these boilers supply steam for stationary engines, which work from 10 to 12 hours a day. About one quarter are used for locomotives, working from 12 to 16 hours a day, the remainder being used in marine engines; again we may take it that about 6,000,000 H.P. is obtained every hour through the use of coal, and as every H.P. requires about four pounds of fuel per hour, nearly *11,000 tons of coal* are used for the *manufacture of steam.*

"*The production of gas*" for lighting purposes forms the second largest manufacture where coal is the most important feature. The average number of gas jets in the world is 1,500,000, and consumption of gas about 5,000,000 cubic metres per hour—therefore 10,000 tons per hour of coal are needed for lighting purposes. Roughly estimated, about 1,000 tons of coal per hour are needed to obtain the material to work the gas engines of the world. To separate one ton of iron from its ore, one ton of coal is needed, and 5,000 tons of raw iron are produced hourly tbroughout the world, and we may calculate that 4,000 tons of coal are used to smelt the other ores. Manufacturing pursuits use 8,000 tons per hour. According to the latest statistics 10,000 tons of coal per hour are used for domestic purposes. The total amount of coal therefore consumed throughout the world, reaches the enormous figure of 50,000 tons per hour or 1,200,000 tons per day, being 438,000,000 tons per annum.

WHEN REPTILES RULED THE WORLD.

For Geology Students.

THERE was a time, in the wide revolving shades of centuries past, when our earth was wholly in the possession of walking, swimming and flying reptiles. Being the dominant type, they divided, naturally, into three great classes. In the oceans they were the gigantic paddling "Enalivsaurians;" on dry land, or, rather wet land (for the whole face of the globe was doubtless a quagmire at that time) they became monstrous, erect "Dinusaurians," some of which had legs 15' long.

Those that inhabited the air were the terrible flying "Pterodactyls." For a vast, but unknown length of time these awful creatures literally ruled the earth. Finally, after they had "seen their" day, they gradually grew less and less, one by one they died out in the face of the younger yet more vigourous fauna, until at the present time only a few miniature alligators and crocodiles, and a few toy snakes and skulking lizards remain, as reminders of the enormous reptiliant types that once over-run earth and sea.

ANSWERS TO QUESTIONS.

Question 1—Discuss some method of transferring power from a vertical water wheel to a shaft 150 yards distant?

Answer to Question 1—

The following is the method employed at Sedling lead mines, Weardale.—A drum 5′ diameter, is keyed on to the main shaft of the water wheel; a wire rope is connected to this drum and carried by means of cross-stays and sheaves to the shaft, which is about 150 yards distant. The rope is carried over ordinary pulleys and attached to a kibble in the shaft, which was being sunk in search of minerals. The wheel is so constructed that the water enters near the top at either side, and falls into troughs or buckets, thus by its weight at the circumference overcomes the resistance at the axle. The drum being keyed to the axle of the water-wheel, is made to revolve either backwards or forwards as the water runs on either at one side of the wheel or the other, the water being regulated by a competent person by means of handles connected to traps above the wheel. The kibble runs steadily and uniformly in the shaft, and was intended to be replaced by cages; it can be stopped or started as surely and safely as by a winding engine.

FRANK GRAHAM,
Keeper's Row,
Tow Lane, Durham.

Question 2—What H.P. would be required to haul 20 full tubs, each weighing $10\frac{1}{4}$ cwt., up an incline rising 1 in $3\frac{1}{2}$. Speed 200 yards per minute, friction of tubs $= \frac{1}{60}$ of weight, neglecting weight and friction of the rope?

Answer to Question 2—

$20 \times 10\cdot25 \times 112 = 22{,}960$ weight of full tubs in lbs., and $200 \times 3 = 600'$, then $\frac{22960}{3\cdot5} \times 600 = 3{,}936{,}000$ foot-pounds per minute, and $\frac{3936000}{60} = 65600$ friction of tubs, then $\frac{3936000 \times 65600}{33000} = 121\cdot26$ H.P. required.

JOHN MURRAY,
Gatehead,
Via Kilmarnock,
Ayrshire, Scotland.

Question 3—Describe the method of working the Staffordshire Seams of thick coal?

Answer to Question 3—

The Staffordshire seams of thick coal are worked by the square method. In working by this method two parallel gate-roads are generally driven to the boundaries, and are separated from each other by ribs of coal which vary from thirty to over forty yards in thickness; these gate-roads communicate with each other at intervals for the purpose of ventilation, and generally serve as the principal haulage roads of the mine; from these gate-roads, bolt-holes or roads are driven right and left into the coal with the intention of forming

a series of chambers or sides of work; these bolt-holes are driven at given distances from each other, and serve as the only place of egress from these chambers, which are separated from each other by ribs of coal 10 yards wide. Two gate-roads are driven in the lower coal and carried nearly to the boundary of the chamber, when they are connected to each other by a cross drift 5 yards wide, which is driven straight from one to the other, and which opens out a face equal to the width of the district and carried back to the boundary of the district, and whilst this is in progress, another cross drift 13 yards back is commenced, which, when completed, forms a rectangular pillar, and its length will thus be equal to the distance between the gate-roads; in the centre of this pillar a stall is commencd and driven right through its centre, thus leaving a pillar or square on each side to support the roof; this process is repeated back to the entrance of the chamber, but at the same time the upper coal is got down by means of vertical cuttings, which enables the coal to fall down in sections. The squares or pillars which are left in as a support for the roof are finally reduced as far as circumstances will permit. These processes of forming pillars in the lower coal, followed by the removal of the upper coal, are continued until the district is completed. Props are sometimes used as a support for the roof, and are from 24′ to 30′ in length, whilst chocks 9′ square are sometimes used, and are found to be very useful as they resist a great amount of pressure.

JOHN THOMPSON,
4, Church Street, Howden-le-Wear,
Via Crook,
Co. Durham.

Question 4—Give an account of the Northumberland and Durham Coalfield?

Answer to Question 4—

This coalfield is basin-shaped. If sinking to the north of the Tees, we should pass through the Magnesian Limestone 600′, which does not possess any minerals, the Limestone being used as a flux in the blast furnaces. The coal formation probably extends over the whole of Durham and Northumberland, excepting the Cheviot district. It may be sub-divided into—(1) The upper coal measures from the base of the Permian to the roof of the High Main Seam about 1,100′, here are found the Hebburn Fell, five-quarter and three-quarter seams. (2) The middle coal measures form the roof of the High Main to the floor of the Brockwell, about 900′; here are found all the best seams of the district, some 16 in number, of a thickness in the aggregate of about 50′; discarding those less than 18″, 30 may be taken as an average. (3) The lower coal measures and millstone grit formation, from the floor of the Brocktwell to the roof of the Fell-top Limestone, perhaps 600′ contain no seams of any present value. (4) The Bernician from the roof of the Fell-top Limestone to the base of the Harbottle Grits, 2,500 to 8,000′; several seams of coal are found here, but they are variable in thickness, quality and extent. (5) The Guedian beds from the base of the Harbottle Grits to the Silurian Formation. *Dykes.*—The most important whin-dykes run East and West and are remarkably uniform in lithological composition. The following may be mentioned, beginning from the north: — Acklington, Bedlington, Hartley and Coley Hill, in North-

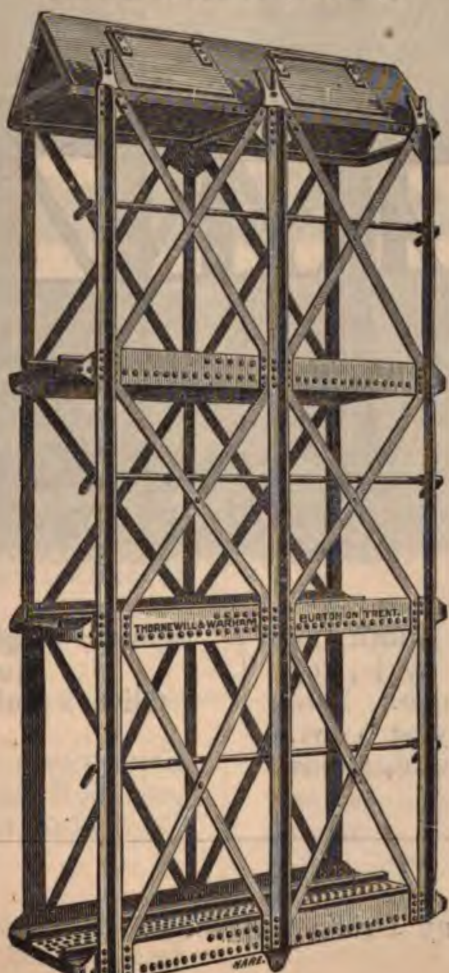
umberland. Hebburn, the southern extremity of Coley Hill, and Hett and Cockfield in Durham. *Troubles.*—These too run for the most part East and West, the most important beginning from the north are dippers south of about 50 fathoms, between Newbiggin and North Seaton; the ninety fathom Dyke, a dipper north, whic hruns from Cullercoats, between Killingworth and Gosforth Collieries, south of Newburn, through Whittonstall, to a little west of Minsteracres, where it dies out. *Stublick.*—a dipper north, which, starting from a little to the south of Corbridge, runs west into Cumberland. *Butterknowle* from Wingate Grange to Butterknowle, a dipper south of 40 fathoms. There are 8,000 million tons of coal in this coalfield, supposed to last about 200 years.

D. B. Douglas,
67, Holly Avenue,
Jesmond,
Newcastle-on-Tyne

Question 5—Sketch and describe, giving weights, etc., of a double-decked and three decked cage?

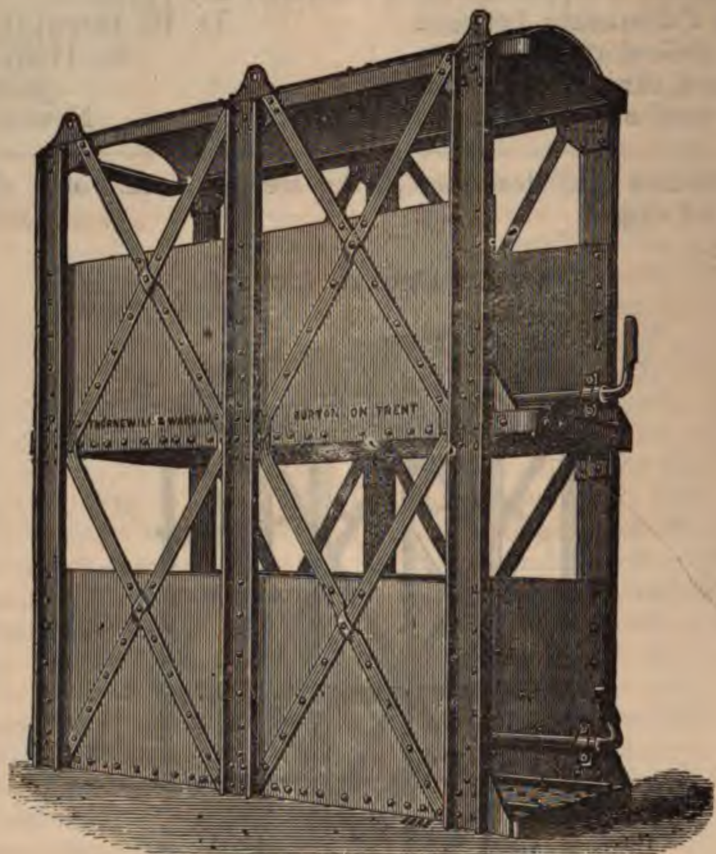
Answer to Question 5—

Three Decker (Steel).



Height 15′, length 9′, width 4′, frames 5″ by ¾″, ribs or stays 4″ by ½″. Top deck 5′ 9″ high; this deck can be used for drawing men and horses. The two lower decks 4′ 7½″ high, weight about 2¼ tons; to draw two tubs in each deck, carryi n 10 cwt. each; total weight of tubs and coal, 4 tons 10 cwt. Both cages are made by THORNEWILL AND WARHAM, Burton-on-Trent.

DOUBLE DECKER.



Height 9′, length 9′, width 4′, frames 5″ by ¾″, stays 4″ by ½″, top deck 5′ high, bottom 4′ high. Two tubs in each deck, carrying 9 cwt. each; weight of tubs and coal, 2 tons 14 cwt.; weight of cage, 1½ tons

JOHN GRAY,
Oliver's Buildings, Glebe Row,
Bedlington.
Northumberlar

Question 6—Describe any Drilling Machine?

Answer to Question 6—

The above sketch is an illustration of the Elliott Drilling Machine which can be used in stone or coal. The frame is of two pieces, the lower half to slide on the upper, to fix it any height, and made fast by a tightening screw attached to the bottom of the top half; it can also be raised or lowered by another screw that passes up the bottom of the lower frame piece. The propelling screw is fed by a toothed wheel with ¼″ pitch that works within a frame, having a regulating screw to regulate the pitch, when this screw is slackened the propeller can be easily withdrawn, the propeller is turned by one or two ratchets. It is made by the Hardy Patent Pick Co., Sheffield, and has given good results.

John Gray,
Oliver's Buildings, Glebe Row,
Bedlington, Northumberland.

Question 7—Give the composition of Gunpowder, Dynamite, Roburite, and how do they differ as explosives?

Answer to Question 7—

The composition of gunpowder is composed of Saltpetre, Sulphur and Charcoal. The ingredients are ground to a paste, and the paste is then carefully dried. Gunpowder was the explosive first used in mining, but it has been succeeded by many so called safe explosives, such as Roburite, Tonite and Dynamite. Dynamite is compounded in different ways, such as—

Gelatinised Nitro-Glycerine	10 %
Ammonium Nitrate	90 %
	100 %

Nitro-Glycerine	75 %
Unctious Earth	25 %
	100 %

Ammonium Nitrate	90 %
Dinitro-Benzine	10 %
	100 %

Roburite is a binary compound of—

Chlorinated Dinitro-Benzine	27 %
Nitrate of Ammonia	73 %
	100 %

Roburite is said to give more useful effect than gunpowder, but it is supposed to be deleterious to the miners health by the fumes that is given off. Dynamite is too quick for blasting coal, but it is more effectual in blasting rocks.

JOHN FOX,
Norton Canes, Nr. Cannock,
Staffordshire.

Question 8—Compare and discuss Ventilation as produced by Fans, Furnaces and Steam Jets?

Answer to Question 8—

In Fan ventilation the air is exhausted out of the mine by means of a large revolving wheel with broad blades, which constitutes the fan and works very closely within a casing, the Fan is open in the centre on both sides, the air enters by the sides and leaves at the ends of the blades and passes up a chimney into the atmosphere, an exhaust fan is generally placed at the top of the up-cast shaft but a compressor at the top of the down-cast shaft, but in deciding the position of the fan we must be guided by Rule 3 in the General Rules of the C.M.R.A., 1887; it must be placed in such positions and under such conditions as will tend to ensure its being uninjured by an explosion. The motion of the air in an exhaust fan is caused by a partial vacuum being formed by the fan constantly revolving and the air keeps rushing forward, thus a constant current is kept up, with a compressor the air is pressed into the down-cast shaft. In Furnace ventilation a large fire is placed at or near the bottom of the up-cast shaft, for the purpose of imparting heat to the air that it may expand and become lighter to get a difference of the weights of the two columns of air in the down and up-cast shafts, and the motion of the air is kept up by the difference between the weight of the air in the up-cast and down-cast shafts, the heavy air presses the lighter air up the up-cast shaft. The difference of the weight between the air in the down-cast and up-cast shafts will give a column of air of such a height that will equal the difference which will be the motive column. Suppose the two shafts are 100 fathoms deep, and the temperature at the down-cast 50° Fah., at the up-cast 110° Fah., the barometer 30″, we can get the difference of the weights of the two columns by the following rule— $\frac{1{\cdot}32529 \times 30}{459+50} = {\cdot}0781113$lbs. weight of a cubic foot of air at this temperature and pressure, then $\frac{1{\cdot}32529 \times 30}{459+110} =$ ·0698746lbs. weight of a cubic foot of air at the up-cast shaft, and $\cdot0781113 - \cdot0698746 = \cdot0082367$lbs. difference in weight of one foot of air in each shaft. $\cdot0082367 \times 100 \times 6 = 4{\cdot}94202$lbs. difference between the weights of the two columns of air or pressure per square foot producing ventilation. The motive

column M $= \sqrt{\frac{4 \cdot 94202}{\cdot 0698746}} = 70 \cdot 72'$. Another way $\frac{110-50 \times 100 \times 6}{459 \times 50} = \frac{36000}{509} = 70 \cdot 72'$. Steam jet ventilation consists of a large number of steam jets placed around the bottom of the up-cast shaft, it has been tried several times but has always been found to be impracticable for general use, but may be used as an auxiliary in case of a break down to the fan or furnace while under repairs. The principle of its action is, the steam escapes at a high velocity and carries part of the air with it, which causes a partial vacumn; its chief defects are, a large percentage of heat is lost in raising the water in the boilers to boiling point, also in the transit; with the furnace the heat is directly applied to the air, and when the steam ascends the upcast a large percentage is condensed and falls as spray, which impedes ventilation. A deep and dry shaft is favourable to the furnace; if wet or giving off fire-damp is favourable to the fan. If a furnace is used and fire-damp given off and not diluted so as to make it uninflammable, we must comply with Rule 2 in the General Rules of the C.M.R.A., 1887, in providing a dumb drift or airway to carry off such inflammable gas clear of the fire. In a shallow mine a fan is most suitable; if the up-cast shaft is a winding shaft the furnace has the advantage. In case of a break-down the furnace has the advantage over the fan, for furnace ventilation will continue many hours after the fire has gone out, while with the fan, just till the energy it has acquired by motion is used up, but as it is only practicable to have the furnace at the bottom of the shaft and the fan at the top, the fan will be better got at for repairs.

JOHN GRAY,
Oliver's Buildings, Glebe Row,
Bedlington, Northumberland.

Question 9—To raise 700 tons per day of eight hours, depth of shaft 350 yards, what size of coupled winding engines would you put down? Give size of cylinders, length of stroke, diameter of drum, number and class of boilers and working pressure of steam.

Answer to Question 9—

For winding purposes, double horizontal engines of various improvements are mostly used, as single cylinder engines are things of the past. To do the work in question, I would put down an engine of about 260 H.P., the size of cylinders 36″, length of stroke 5′, making about 16 revolutions for each wind, a drum of 14′ diameter, with a working pressure of 50lbs. In order to calculate the H.P. of an engine, we proceed as follows—Multiply the weight in lbs. by the depth of the shaft in feet, and divide by the units of work in a H.P., the time in minutes for the work to be done in and allow a modulus of ·4 for work not taken into consideration, thus—

$$\frac{700 \times 2240 \times 350 \times 3}{8 \div 6 \times 33000 \times \cdot 4} = 260 \text{ H.P.}$$

The size of the cylinders can be found by multiplying the units of work in one H.P. by the H.P. of the engine, and divide this product by the pressure of steam and by the speed of the piston in feet per minute (that is the revolutions doubled and multiplied by the stroke in feet) thus—

$$\sqrt{\frac{33000 \times 260}{50 \times 16 \times 2 \times 5}} = 36'' \text{ nearly.}$$

In choosing boilers, preference should be given to the Lancashire ones, as they are good steamers, also less fuel is required than that of the cylindrical boiler, although some persons prefer the latter where the feed water contains considerable quantity of sediment, on the other hand some practical engineers main-

tain that by using the Lancashire boiler it is less expense, even though the feed water be impure, by the consumption of fuel saved. The ability of boilers to supply an engine with a given indicated H.P. is not so easily estimated, the required number depending upon the quality of the coal, skill of the firemen, &c., therefore we have to a great extent to depend upon practical observations, and I think two Lancashire boilers would be amply sufficient.

JAMES RIDDLE,
Delight Colliery,
Depton, Co. Durham.

Question 10—Sketch the method of working coal known as Bord & Pillar?

Answer to Question 10—

This has been awarded to
RALPH GREEN,
26, George Street,
Kimbleworth Colliery,
and will be reproduced in due course.

We intend to give a number of Questions that have been asked at Examinations for Managers, Under-Managers, and at the Science and Art Examinations, for which we shall give a uniform reward of 1/- for the best original answers, subject to the following conditions, which must be observed in all competitions :—

(1) To be written on one side of the paper only.

(2) The name and postal address must be attached to every answer.

(3) They must reach us by March 7th, 1893 (also "Silver Medal" competition).

(4) Write "Merit" on left-hand corner of envelope.

Question 1—Explain with a sketch the whole process of coking coal as carried on in the county of Durham. Show one oven connected with a main flue?

Question 2—Sketch and explain the water gauge and its use, giving examples?

Question 3—Describe the method of underground haulage by the endless chain system, what are its advantages and disadvantages?

Question 4—How is slate mined in North Wales?

Question 5—At what rate would it be necessary to work a 15″ pump, 6′ stroke, to keep down a flow of 250 gallons of water per minute in a shaft 280 yards deep, and what H.P. will be required?

Question 6—What kind and size of Fan would you put down for 90,000 cubic feet of air per minute. Give speed, size of engine, cylinder and stroke, and how would you test the fans efficiency?

Question 7—How would you proceed to repair an old shaft, and how would you ventilate it?

Question 8—Give the simplest methods you know to extract the "square root" "and cube root" of any number—extract the square root and cube root of 7854?

Question 9—State fully the duties of a Certificated Manager under the C.M.R.A. of 1887?

Question 10—What gases are found in mines, and what are their chemical composition?

SILVER MEDAL COMPETITION.

This competition closes on the 7th March, 1893, and all articles, etc., must reach us not later than that date. For full particulars see No. 5.

IMPROVEMENT PRIZE.

Result in our next.

Printed and Published for the Proprietor by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

// MINING

A Journal devoted to the interests of Mining.

No. 8. Vol. I. March 9th, 1893. FORTNIGHTLY ONE PENNY.

MINING NEWS IN GENERAL.

The Coal Trade, if anything seems duller this week than when our last notes were written. The reports from all the various districts are bad—the "month's play" would not be so wise as the suggested four days a week; the Conference will have met by the time these notes are read, and then our readers will know with what result.

***

The depression in the Iron Trade seems to continue, notices have been posted up at the Wigan Coal and Iron Company Works, stating that all contracts and engagements terminate in 14 days, this means that a large number will be thrown idle.

***

A lad employed as a pony driver at the Trowel Moor Colliery, Stapleford, has been sentenced to six weeks hard labour, for wilfully damaging an endless wire rope used for hauling tubs up an incline. The strands were found to be wilfully cut, and if the rope had parted it might have resulted in a serious loss of life, the only reason the boy gave for this mad trick was that he wanted a "day off" from the colliery—he now is enjoying part of his six weeks, which he thoroughly deserves.

***

The Editor of the "Mining School Journal" has commenced a new tale, entitled:—"Annie Lowe, the Colliery Lass": this should prove interesting to fiction readers.

***

The Silver Medal Competition which has just closed, has proved very popular amongst our readers, and we must compliment the competitors upon the merit of the articles that have been sent in—we shall announce particulars of another on the same lines shortly.

Our next issue being the "Silver Medal Edition," there will, no doubt, be a run on it, so place your orders early.

***

The Editors of the "Labour Tribune" have sent us a copy of the "*Eight Hours Day*"—this is a very interesting and exhaustive little shillingsworth, and well worth the money asked.

***

We shall be pleased to insert any general information on this page that may be sent by our readers.

***

The Eight Hours Day is being tried at the Salford Iron Works, from February 20th. Messrs. Mather and Platts began running their works 48 hours per week instead of 53, and intend to give it twelve months fair trial, depending upon their workpeople to make it a success; this is another step in the right direction, and we trust that the workpeople will appreciate this system by their increased energy and punctuality.

***

The Ballarrat Miners(Australia) Association, spent £980 in strike pay last year as follows—Defence committee at Broken Hill, £800; for the wives and children of the imprisoned miners, £50; and £130 was spent during the strike in Tasmania.

***

The affairs connected with the Granville strike are becoming a matter of great consideration, their is at present no signs of any settlement being arrived at, a few men have returned to their work but the majority are still standing true to their cause.

***

On Saturday, February 25th, an explosion took place at Messrs. Hill, Plymouth & Co.'s No. 2 pit, through the use of naked lights, six men were injured, and one or two rather seriously.

LECTURE I.

CHEMISTRY IN MINING.

HYDROGEN.—Small quantities of this gas are given off by active volcanoes, but it is seldom found in nature in a free or uncombined state. It is always a constituent of fats, oils, and resins; consequently, wherever the resinous remains of vegetable matter are found, there we find methyl hydride or marsh gas. In the autumn of the year, decayed leaves and vegetable tissues, fermenting in pools and stagnant ditches, give off this gas abundantly; but this is not pure hydrogen, but $C\,H_4$. Hydrogen can be produced by artificial means, and we advise the student to make himself practically acquainted with the processes. Hydrogen can be prepared in two ways: First—When steam is passed through a red hot iron pipe containing small scraps of iron we have $H_2\,O + Fe.$; but to obtain a complete multiple number, we proceed with four molecules of water and three atoms of iron, or four volumes of water and three volumes of iron, and thus obtain magnetic oxide of iron and free hydrogen, thus:—

$4\,H_2\,O + 3\,Fe. = Fe._3\,O_4 + 8\,H.$

If the remaining steam and hydrogen be passed through cold water the steam is condensed, and the pure hydrogen may be collected by an inverted jar filled with water. Second—If a bottle be charged with a few pieces of sheet-zinc cuttings, and half filled with water containing one-sixth of its volume of strong sulphuric acid, the acid and the zinc will form new combinations, as follows:—One molecule of sulphuric acid, and one atom of zinc, $H_2\,S\,O_4, + Zn = Zn\,S\,O_4 + H_2$ so that two volumes of Hydrogen are set free. By putting the shank of a tobacco pipe through a cork in the bottle neck, the Hydrogen may be collected in a bladder for future experiments.

OXYGEN OCCURS FREE IN THE ATMOSPHERE MIXED WITH NITROGEN.

The best way to prepare Oxygen artificially is the following:—Get powdered potassium chlorate (2 oz.), mix with clean sand (1 oz.), and put the mixture into an iron pipe with one end closed; connect the other end by some means with a bladder, and insert the closed end in the fire; very soon pure oxygen gas will be given off. The gas will cause the most intense ignition if any lighted substance be placed in it. To show the experiment, a bottle should be filled with it, and if very fine iron wire, with a lighted thread on the end be plunged into the gas, the iron will burn with the most beautiful scintillations. Fill a bladder with one-third Oxygen and two-thirds Hydrogen, taking care to have a suitable small brass pipe with a tap inserted in the neck of the bladder, and to keep yourself away from all lights while you hold the bladder. Now, blow a little of the mixed gases into a dish containing soap water "milk warm," and after carefully removing your bladder, throw a lighted piece of paper into the foam produced by the injected gases, when a violent explosion accompanied by a loud report will ensue. In this way and by no other, can you have proper ideas of explosive mixtures. You will here see that by taking one-third by volume of Oxygen, and two-thirds by volume of Hydrogen, you have formed water which is made up of three atoms, $H_2\,O$. It has been noticed that nearly one-fifth of the air we breathe is oxygen in a free state. Five volumes of air would

give up one volume of Oxygen, and that added to two volumes of Hydrogen would be an explosive mixture. It will here be seen that the four volumes of Nitrogen do not assist in the explosion, and remain unaffected by the chemical action set up. Nitrogen occurs in a free state in the atmosphere mixed with Oxygen, and is easily prepared as follows:—Take a large glass jar full of air, and having inverted the jar suspend in it a piece of burning phosphorous, taking care to place the jar, which is now mouth downwards, in water; white fumes at first seem to fill the jar, but these are soon absorbed by the water, leaving almost pure Nitrogen in the vessel. This gas is the principal constituent of after-damp in mine explosions. It is not poisonous, as has been shown, and its function with regard to the animal economy and ordinary combustion is to dilute the Oxygen, otherwise pure Oxygen would burn up the tissues of the living organism, and the iron bars or other fittings of our fire places and furnaces would burn and melt like wax in the flame of a candle.

Carbon Monoxide is produced when carbon is burnt in a limited supply of air. It can also be produced for experimental purposes by passing carbon dioxide through an iron tube kept at a red heat and containing red hot coke. The lambent flames on a coke fire are produced by carbon monoxide burning in air, here $C\,O$ takes an O from the air and becomes $C\,O_2$ or carbon dioxide. Carbon monoxide is a poison, and will not of itself support combustion. It will, however, burn in air when lighted like gas at the open end of a pipe.

Hydrogen Sulphide is produced in nature chiefly by the decomposition of sulphates in the presence of organic matter. Let it be carefully noted that the boiling point of water varies directly as the pressure. For example:—When the barometer shows a pressure equal to 30″ of mercury at the sea level, at such level water boils at 212° F., while, at an elevation of 600′, boiling point is 211° F., and at an elevation of 1,200 nearly, the boiling point is 210° F. Now, as 600′ is equal to 100 fathoms, it follows that the boiling point rises directly as the depth, increasing 1° F. for every 100 fathoms of descent.

Carburetted Hydrogen.—$C\,H_4$ is the chemical formula of marsh gas, which is a chemical compound of two elementary bodies, whose united atomic volume is equal to the volume of two atoms of hydrogen. Now the carbon atom will require for complete combustion two atoms of oxygen also, making altogether four atoms of oxygen; but as we have already noticed, the five atoms on chemically combining would be condensed into the volume of two. Now divide the four atoms by two, and there will remain two volumes of oxygen to completely burn up one volume of marsh gas. But the oxygen in the air is only ·21 of its volume, therefore, $\frac{2}{21} \times 100 = 9{\cdot}52$, the volumes of air required to completely burn up one volume of marsh gas. After an explosion of one volume of fire-damp with 0·52 volumes of air, the resultant gases would be carbonic acid $C\,O_2$, watery vapour $H_2\,O$, and nitrogen N, the whole constituting that deadly atmosphere called after-damp, and making, the moment after the explosion, the following mixture:—

Nitrogen or N	= 71·48	per cent.
Watery Vapour or $H_2\,O$	= 19·01	,,
Carbolic Acid or $C\,O_2$	= 9·51	,,
	190·00	

But the watery vapour will immediately condense, leaving the after-damp as a mixture of nitrogen and carbonic acid of the following proportions per volume, per cent. :—

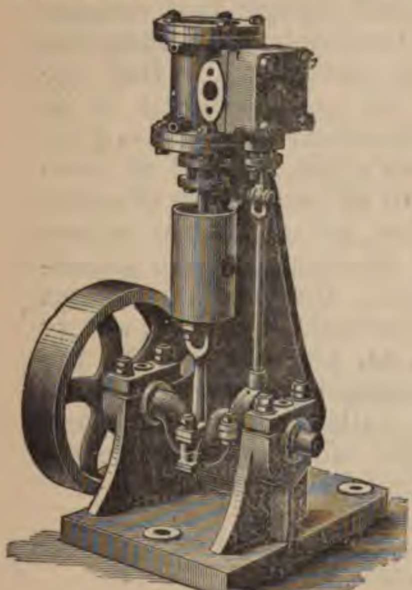
Nitrogen or N	= 88·26
Carbonic Acid or $C\,O^2$	= 11·74
	100·00

Perhaps these proportions would be better retained by the memory, by saying: after-damp is a mixture of 88 per cent. nitrogen, and 12 per cent. carbonic acid. At the moment of explosion the proportions are: 70 per cent. nitrogen, 20 per cent. steam, and 10 per cent. carbonic acid. It would perhaps be safe to say that in no case, in an actual mine, an explosion has occurred with a true chemical mixture of 9·52 of pure air and one of marsh gas.

(Description of $C\,O_2$ is unavoidably held over.)

MINING APPLIANCES.

BELOW we give a sketch of a very successful method of cleaning lamps by machinery where a large number of Safety Lamps are used, this method cannot be too highly recommended, it is manufactured by **Johnson, Clapham & Morris, of Manchester,** the lamp cleaner is run by the small engine shown, and one man can clean a large quantity in one shift.



We intend to give a number of Questions that have been asked at Examinations for Managers, Under-Managers, and at the Science and Art Examinations, for which we shall give a uniform reward of 1/- for the best original answers, subject to the following conditions, which must be observed in all competitions :—

(1) To be written on one side of the paper only.

(2) The name and postal address must be attached to every answer.

(3) They must reach us by March , 1893.

(4) Write "Merit" on left-hand corner of envelope.

Question 1.—Describe some Drilling Machine for drilling holes during the operation of Sinking ?

Question 2.—What is the difference between *Carr's* Disintegrator and *Blake's* Crusher ?

Question 3.—What is the American methods of Timbering? Give sketches.

Question 4.—Explain the first law of Ventilation ? Give examples.

Question 5.—Explain the second law of Ventilation ? Give examples.

Question 6.—Explain the operation of Sinking a Metal Mine Shaft ?

Question 7.—What sort of Air Crossings do you prefer ? And why ? And what is their relative cost ?

Question 8.—Describe and the approximate cost of *Poetchs* Sinking process ?

Question 9.—How is Tin, Lead, and Copper found, and how are they prepared for the market ?

Question 10.—How is Iron mined ?

SILVER MEDAL EDITION.

IN our next issue we shall announce the winner of the Silver Medal, and it will also contain the Prize Articles on Sinking, Boring, Ventilation, Methods of Working a Seam, Haulage, &c., &c. The Articles are remarkably good, and we must congratulate our readers upon the excellence of their contributions. Before we announce the particulars of the next competition we should like any of our readers to express their opinion of any alteration or improvement that they may suggest, and we will give it our due consideration; also with the "Article Competition" that commences in this number, and we trust that this will become as popular as the many others that we have announced, and let the following be your motto :—

"If at first you don't succeed,
Try, try, try again!"

Editor of "Mining."

WINDING.

Chapter V.

IN our last article we gave an illustration of a pair of the latest compound Winding Engines—the illustration with this article is one of the modern Iron Head-gears, and we purpose giving a prize of 2/6 for the best description of the advantages of an iron one over the wooden Head-gears; also the sizes of the pulleys and structure generally, as our reader would have it to wind say—1,000 tons per day. Continuing our article on "The advantages of Compound Winding Engines," the

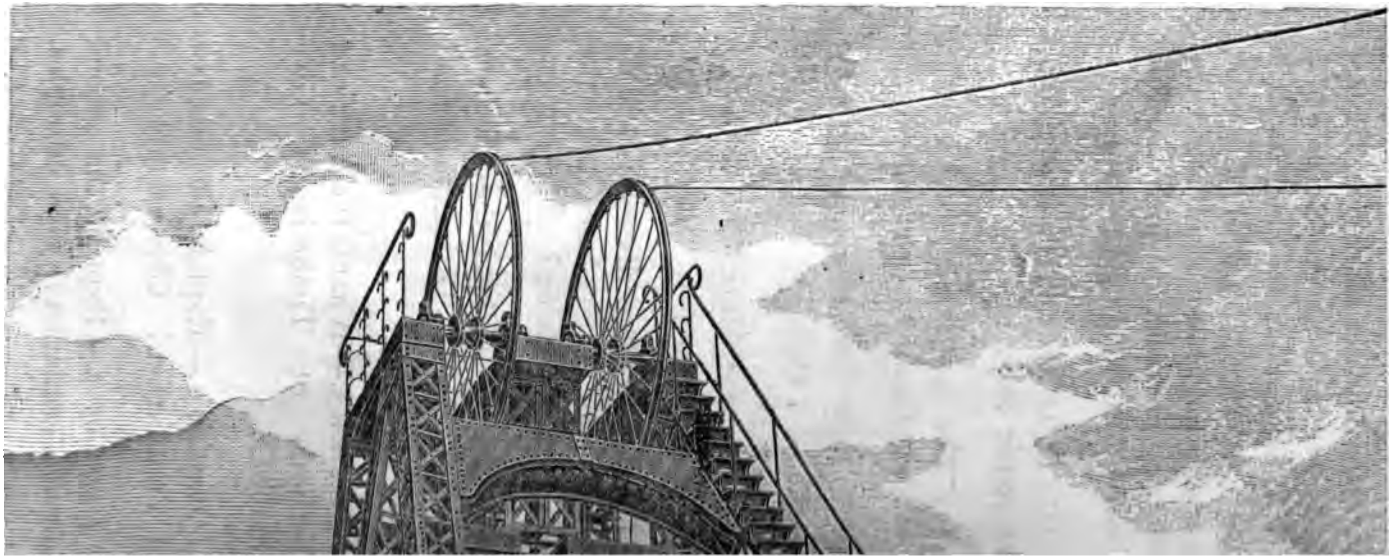
And again in the third cylinder, we shall have $4\frac{1}{3}$ expansions from 13lbs. per square inch at the commencement of the stroke, and 3lbs. per square inch at the end, thus:—

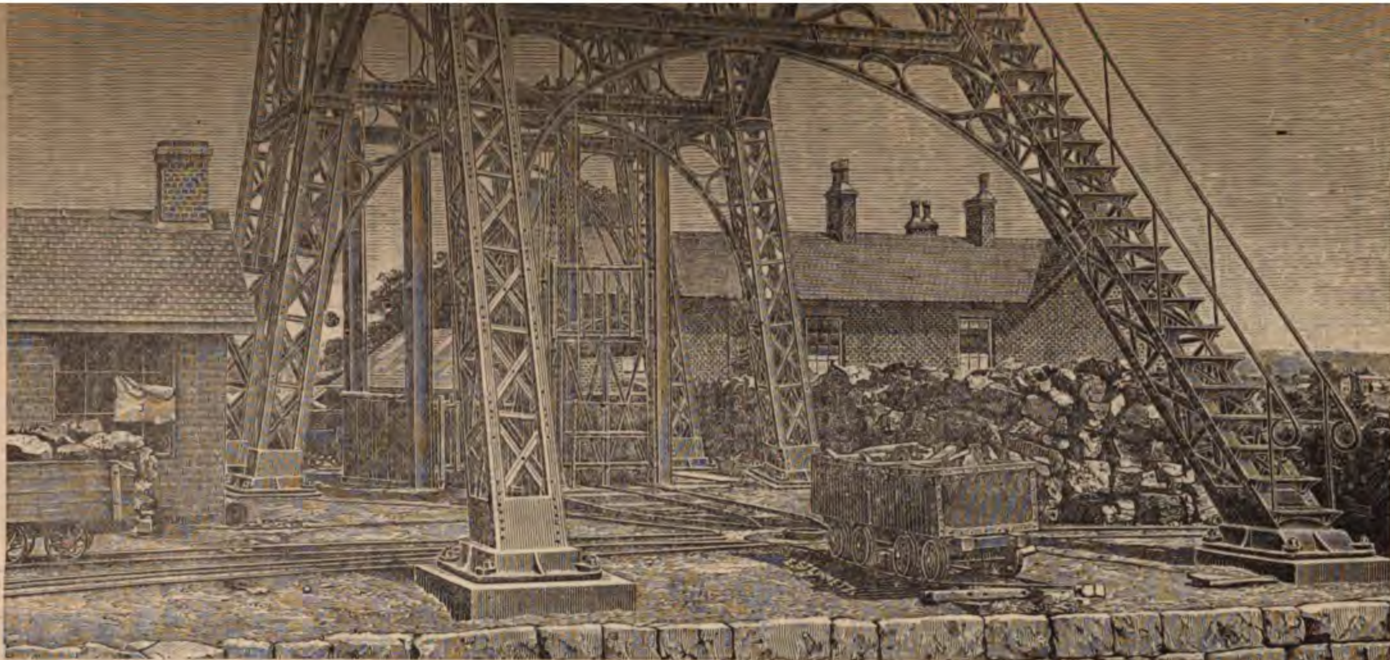
$$\frac{13 \text{ pressure at the commencement}}{4\frac{1}{3} \text{ expansions}} = 3$$

So that we have 81 expansions thus—($4\frac{1}{3}^3 = 81$) without the great strain and variation of heat, "*Quadruple Expansion Engine.*"

1st Cylinder — Steam 243lbs. per square inch absolute—3 expansions $= \frac{243}{3} =$ 81lbs. per square inch.

2nd Cylinder—Steam enters at 81lbs. per square inch absolute—3 expansions $= \frac{81}{3} =$ 27lbs. per square inch.





"*Triple Expansion Engines.*" As an example, we will take a pressure of 243lbs. per square inch absolute, it will expand in the first cylinder $4\frac{1}{3}$ times, being from 243lbs. per square inch at the beginning of the stroke, and 56lbs. per square inch at the end, as:—

$$\frac{243}{4\frac{1}{3}} = 56$$

In the second cylinder, the number of expansions will be as before $4\frac{1}{3}$ times, from 56lbs. per square inch at the beginning, to 13lbs. per square inch at the end of the stroke, thus:—

$$\frac{56}{4\frac{1}{3}} = 13$$

3RD CYLINDER—Steam enters at 27lbs. per square inch absolute—3 expansions $= \frac{27}{3} =$ 9lbs. per square inch.

4TH CYLINDER—Steam enters at a pressure of 9lbs. per square inch absolute—number of expansions $3 = \frac{9}{3} = 3$lbs. per square inch. Again we have 81 expansions, as $3 \times 3 \times 3 \times 3 = 81$ expansions in the four cylinders.

In our next articles we shall discuss the advantages of compound engines over the ordinary one cylinder engines—the head-gear of which we illustrate is manufactured by **Thornewill and Warham, Burton-on-Trent,** and is now being universally erected.

An ADDRESS by Mr. C. M. PERCY.

What is a Water Gauge?—*Contd.*

ONE end communicates with the fan drift where the exhaustion prevails, and the other end communicates with the fan engine house where no exhaustion prevails. The water gauge is partly charged with water, and the water under the influence of the diminished pressure on one side rises in that leg. The difference in level of the water in the two legs is called the water gauge in inches and represents the ventilatory column. The ventilating column is just as effective as if we had pressure ventilation represented by that column. A column of water one inch high exerts a pressure of 5·2 or 5⅕ pounds per square foot, and there we have the explanation why we adopt in our calculation the water gauge in inches and the 5·2. We may consider our fan drift as a cylinder of so many square area, the velocity of the air, the velocity of the piston, and the water gauge in inches multiplied by 5·2 as the pressure on the piston in pounds per square foot.

What is the Useful Effect of a Fan?

The term useful or efficiency of a fan is one of common use. What does it mean? The engine which drives the fan generates a certain amount of power, the fan which the engine drives produces a certain amount of ventilating power, the power of the fan is always less than the power of the engine. No machine, no engine, can give out all the power put with it, the resistances of the engine itself and of the fan itself absorb some power. The useful effect of a fan is the proportion which the ventilating power produced bears to the power of the engine. For example, suppose a fan engine generates 120 horse power, and suppose the fan produce 90 horse power of ventilation. Then as 120 is to 80, so is 100 to 75, which is the useful effect or efficiency of the fan, namely 75 per cent.

A Good Colliery Steam Boiler.

Our remarks concerning machanical ventilation could not be complete unless we dealt with boilers to generate the steam and engines and gearing to drive the fan. The special object of a steam boiler is to generate the needful steam at a sufficiently high pressure to supply the engines to be worked, and at a colliery there are different engines for different purposes, but using steam chiefly at the same pressure. The most popular boiler at well arranged collieries is the Lancashire boiler, so-called because first worked in Lancashire. It is a cylindrical structure, with flat ends and two flues or tubes passing through the entire length. The best dimensions are probably about eight feet diameter, and about thirty feet long, with flues about three feet diameter each. Of these dimensions, and made of steel plates, they will safely work at a pressure of 100lbs. per square inch, and generate from 300 to 400 horse-power each. A pound of coal will probably convert 10 pounds of water into steam, and the consumption of coal will not be less than 2½ pounds per horse-power per hour; in many cases much more, increasing with the imperfections of the engine in which the steam is used. The Lancashire Boiler is

not so economical as the Marine Boiler, but is popular at collieries because it can be strongly and easily made, and inspected and cleaned, not very liable to get out of order, a rapid stream generator, and capable of working at the requisite pressure. No doubt, it may come as a surprise to some that steam at so high a pressure as 100lbs. is used for colliery work; pressure so high was not used in former days, and it might be asked what are the advantages? That will not be difficult to explain. Some proportion of the pressure is absorbed without doing useful work, in moving the engine itself; that amount need not be more with high pressure steam than low, consequently the proportion is greater for useful work. Higher pressure will do more work with smaller engines, and the measure of the possible efficiency of steam in an engine is the difference between the pressure commencing the stroke in the cylinder and the pressure ending the stroke; therefore, the greater the boiler pressure the greater this possible difference and possible efficiency.

How is a Fan driven?

And now the question of actually working the fan has to be dealt with, and this is a case in which the engine runs continually for hours and days, and affords the best opportunity for economical working. The engine should be condensing, that is to say, that it should exhaust into a condenser and remove atmospheric pressure, amounting approximately to 15 pounds per square inch, increasing the power so much. The engine should be compound, which means that the same steam should be used successively in more than one cylinder, thus affording the highest possible rate of expansion, and the highest possible efficiency. It should always be remembered that the best steam boiler is the one which generates most steam with the smallest weight of coal, and the best engine is the one which does the most work with the smallest amount of steam. In marine practice we have the greatest economy in boilers and engines, because, not only does the coal cost so much per ton, but every ton of coal saved represents a ton more of cargo that can be carried.

Connection of Engine with Fan.

With a large fan 40 or 50 feet diameter the number of revolutions is comparatively small, not exceeding 30 or 40 per minute, and the engine is coupled to the fan direct. But with smaller fans, which are becoming more popular, the number of revolutions may reach 200 per minute, and it is not good practice to run an engine so fast; 250 piston feet per minute should be a maximum. Spur wheels would be noisy and liable to break. Straps are often used, and work well, and rope gearing is also adopted to a considerable extent. A number of ropes work in separate grooves on drum pulleys, and make no noise. They have a better grip, and do not need to be kept as tight as a rope.

Duplicate Fan Engine.

A fan ought to be continuously at work with at any rate as little stoppage as possible; therefore, as engines will need rest and repair at times, there should always be a spare engine which can be connected in a few minutes. It may be said, "Suppose a fan gets out of order."

(*To be continued.*)

ARTICLES BY READERS.

"To Editor of Mining."

Dear Sir,

I have been considering what would be a good plan of improving your very valuable mining paper, and I have come to the conclusion, that if you would reserve a space in every issue for the many of your readers to contribute to (and I therefore contribute the following article on "Sinking"), it would be not only appreciated, but would be the means of bringing out a good deal of latent talent.

Yours faithfully,

Terplitz, P.——A——.
Austria.

We are always pleased to receive suggestions from our many readers, and will offer a Prize of 2/6 for the best original article on any subject, and of any length, until further notice. Mark envelopes "Article Competition," and observe the same rules that apply to the other Competitions.—Editor of "Mining."

SINKING.

Various methods of sinking have been tried and adopted in different countries according to their suitability to the peculiar circumstances of the country in which the shafts have been sunk. While the methods have been varied, the shape of the shafts have been principally the oblong and circular. Metal mining countries, such as Cornwall, in England; Transvaal, South Africa; and several of the metal mining states of America, have adopted the oblong shape, and in Germany it is only somewhat modified, the short ends being rounded. The oblong serves its purpose fairly well on hard strata, and where the area of the mine is small, but on soft ground the cost of timber is a serious item, and whilst limiting the space enclosed, has the double disadvantage of being weaker to commence with, and of growing weaker as it grows older, decay of the timber finally bringing the sides in. It is also very dangerous on dry shafts, so much timber being used, as witness the disastrous fire at Kimberley, South Africa, a few years ago. Sinking in this shape is sometimes carried on with four plumb-lines (one at each corner inside of timbering), but generally with one *movable* plumb-line attached to a reel above. The sinker to keep the shaft extra size to allow for timbering, size of timber to be according to depth of shaft and nature of ground. The sinker must always be very particular in the bedding and fixing of his "sets," that each end of each side and each corner be *perfectly level* with the other, to effect which he must use a spirit level or plumb-bob, or both, and the plumb-line. The stone or clay secured with backing deals put behind. The circular shaft is begun extra large to allow of subsequent bricking or "walling" up. When about 6' down, if in clay or hard soils (if in sand we must pile through), a ring of oak "cribbing". is laid in the bottom of the shaft, and props, standing on top of this ring, support the next crib and keep it level, continued in this manner to some little distance above the surface, to give the water a cast from the shaft, it is made perfectly close by backing deals, which are put behind the cribs. It is then continued in the clay, the diameter of the inside of the cribs as far as is safe, when more cribs are put in, the clay in this case being shorn back upward. The

plumb line is hung in the centre, and a measuring lath is used to keep the shaft true. Having reached a good sound stone, a bed is made, levelled, and dressed smooth for the ring of walling, which is packed tightly behind with clay, course being built upon course to the surface, as much of the cribbing being taken out as possible. In walling up below this, the stone is cut out, piece by piece, and the "closers" put in, so that the rings above are never undermined. Metal tubbing is put in where the strata is shedding much water, the wedging of the metal crib, or foundation on which the tubbing is built, being so important (as also between each segment and ring) that when finished wedges can no longer enter, and the tubbing is water-tight. A crib is put in five or ten fathoms. The leading features of this form are its permanency and strength—some very old shafts here showing no signs of failing yet—and it is better to sink under difficult conditions, as sand, gravel, and water and soft strata, and it has more space available for ventilation and pumps. *Kind and Chaudron's* Chopping Revolving Chisel Method is only done in this form, and it suits the freezing process best also.

QUERIES BY READERS.

When there is as much as $\frac{1}{30}$ per cent. of gas, its presence can be detected by the flame of a lamp, so that for every cubic feet of the above mixture I would add 35 cubic feet of air: thus, 10,000 × 35 = 350,000 cubic feet of pure air required.

Now, should this not be 1 of gas in 30 of air, since $\frac{1}{30}$ per cent. means that the flame of a lamp will detect gas to the small amount of 1 part gas in 300 of air? Moreover, I cannot understand of what use the 5 per cent. detective-power given in the question is, since it is not used in answering the question, and, neither is the proportion 1 of gas to 9·5 of air. Will you kindly explain these things to me and oblige.

Yours truly,

(Inquirer).

Will you kindly insert this query in your columns, if it is not encroaching too much on your space—

Can any reader inform me of an India-rubber gas tubing which, after a few days' use, does not become thoroughly impregnated with gas?

Yours truly,

T. M.

Will any of your able correspondents kindly answer the following question—" If there is more or less gas ($C\ H_4$) given off at a downthrow or up-throw hitch, and oblige,

R. R.

To Editor of "Mining."

ANSWERS TO CORRESPONDENTS.

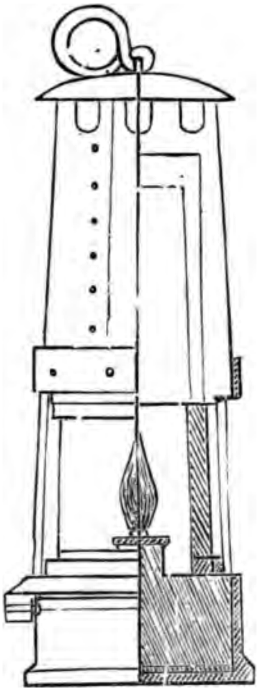
Americus.—All the back numbers of "Mining" can be obtained through your newsagent.

Competitor.—The Silver Medal Competition was open to every reader. 2—Another will be announced shortly.

Hawk. (Hindley).—No, thank you; we do not feel disposed to start a tale, although "Mining Jokes" are always acceptable.

Student (Barnsley).—You will find "Greenwells" a good book, and at the price now offered it is remarkably cheap.

Safety L. (Bury).—We herewith give you the sketch of the lamp you wanted:—



Querist.—You will see that the "electricity relating to mining," has been resumed.

Agent.—Thanks for remarks. 2—Cannot say definitely.

Timberer.—Larch is the best to use for the purpose you name.

L. M. N.—The chemical formulæ is $C_2 H_6 O + H_2 SO_4 = H_2 O, H_2 SO_4 + C_2 H_4$ this being the Olefiant Gas.

MINING DUST.

The Russians have scarcely made any progress with their Siberian Railway this year.

The American Anthracite coal trade is much more brisk now than it has been for some time.

⁂

One cubic foot of ordinary pit timber will absorb one gallon of tar oil.

⁂

A Llanelly miner, who has just died at the age of 87, never rode in a railway carriage, and wherever he went he always walked. He worked for the same employer 78 years, and lived in the same house for 63 years.

⁂

The time taken to tan the skin of an elephant is 5 years.

⁂

Another use for peat is to smelt iron, which it does at a very low cost.

⁂

The new Tin mines opened in Tasmania, will shortly be the largest in the world.

⁂

The anthracite coal found some time ago in Canada, is of excellent quality.

⁂

The Tyrone collieries have just found a seam 20″ thick of good quality.

⁂

A boiler working at 50lbs. was in use in 1804.

⁂

IMPROVEMENT PRIZE.

This is awarded to

Jno. Gray,
Oliver's Buildings, Glebe Row,
Bedlington,
Northumberland,

who says that "to improve 'Mining' is impossible," and "I will improve the sale by giving copies to my mining friends."

Printed and Published for the Proprietor by Strowger and Son, Clarence Yard, Wallgate, Wigan.

MINING

A Journal devoted to the interests of Mining.

No. 9. Vol. I. MARCH 23, 1893. FORTNIGHTLY ONE PENNY.

Silver Medal Competition.

We have awarded the Silver Medal to WM. SHEDDEN, Riccarton, Kilmarnock, N.B., whose articles show a great amount of originality, and also the Diploma of Merit. We have also awarded the Diploma of Merit to JOHN GRAY, Glebe Row, Bedlington, and JOHN FOX, Norton Cranes, near Cannock, Staffs.

In our next number we shall announce the winner of the Article Competition. Editor "Mining."

MINING is an industry which demands from the very outset a large outlay of capital with no prospect of any return for a considerable time; and no person with sound business principles, will embark on such a risky venture without first endeavouring to get all available information regarding the ground fixed upon for such operations, such as the quality and thickness of seams, the depth to them, and the nature of strata, which must be passed through to reach them. To get such information, the surest and most reliable way is to put down a bore-hole, or as many as may be thought necessary to give satisfactory results.

MINERAL BORING.

IN the West of Scotland where the coal and other mineral seams lie conveniently near the surface, compared with many localities, the method of mineral boring is in the simplest possible manner. A set of shearlegs are erected, with a pulley fixed at the top, some 20 feet high or so, with a windlass for drawing and lowering the bore-rods, which are in lengths of 1, 2, 3, 4, 6, 12, and 18′ × 1″ square iron, swelled out to about 1½″ diameter 3″ from the ends, each rod having a male and female screwed-end for jointing. A long, heavy tree lever is mounted on a frame with a hinge-bolt driven through to steady the lever, but allow it to swing freely. The heavy or butt end of the lever, projecting about 3′ over, and connected to the bracehead at the top end of the rods. A cross-bar is fixed on the other end of the lever, by which the labourers (who stand on a raised platform) pull down, which raises the rods up the bore-hole. They then throw up the end of the lever with freedom, and a steel chisel attached to the lower end of the bore rods descends with force on the bottom of the hole, the leader at the bracehead slightly turning the chisel every stroke. The chain connecting the rods to the lever is dropped a link every now and then to keep the lever properly balanced until the rods are lengthened by a short additional piece. Where the metals are soft the bore-hole is protected with sheet iron tubes, which are again drawn when the boring is finished. In cleaning the hole the rods are drawn in as long lengths as the height of the triangle or shearlegs will allow, and the pump—which is a long tube with a valve fixed in the bottom of it, and

a slot hole at the top end (to allow air and water to escape), is lowered by a small wire rope to the bottom of the hole, when it sinks down through the borings, which are held in the pump by the valve in the bottom of it, until it is drawn to the surface and carefully examined, and entered in the journal of the bore. When the depth is too great for the former method to be adopted, a small portible engine and boiler is used instead of manual labour; but latterly, when deep holes are to be bored, it is generally done by the "Diamond system," which is as follows:—A set of coarse diamonds are securely fixed in a steel holder or short cylinder about 5″ in diameter outside, and with about $3\frac{1}{2}$″ hole in the centre and about 6″ long. A small part only of the diamonds projecting from the holder which is screwed to steel tubes running up to the surface. They are then made to revolve at a smart velocity of from 240 to 280 revolutions per minute from the engine above. The borings in a solid core pass up the hollow tube, and when drawn it gives the borer a more correct idea of the nature of the metals gone through. This system, however, cannot be well applied to advantage in passing down through a locality where old workings have formerly existed, as the metals are broken and damaged, and the diamonds have no effect. They are even sometimes torn from the socket of the holder, which is serious, either in their ultimate loss, or in the delay caused in picking them up again. Some great ingenuity however has been displayed by borers in recovering these diamonds, but where the strata is sound and the required depth great, diamond boring gives the foremost *results.*

SINKING.

BEFORE commencing to sink (assuming this to be the first pit on the estate about to be wrought) a carefully made out plan of the estate should be procured, with the position of all the bore-holes and other landmarks accurately put on, and the plan ought to be studied thoroughly to get every possible advantage that is to be had in fixing the best spot for the shaft to go down, for much can be gained and much can be lost at this point of the proceedings. The shaft ought to be conveniently near the dip boundary of the mineral field, where the greater part of the workings will be to the rise, which is a great advantage, for the running of the mineral and the draining of the mineral field of water can be done by gravity. And to have the pit as near the railway as convenient deserves some consideration; but much depends on circumstances in choosing a spot to sink. Having fixed on where to sink the pit and the metals (as seen from the journals of the bore-holes) showing an ordinary dip and rise, square off the shaft to the required dimensions if it is of the ordinary oblong form, keeping the ends of the shaft to the dip and rise of the metals. In beginning to sink make sure and have plenty of good substantial material laid down, and see that only thoroughly experienced sinkers are engaged. If the water is not too heavy at first, sink 10 or 12 fathoms with the windlass, which will give a basis in laying down the plant. Erect the engine, boiler, and pit-head frame, and, if necessary, get the pumps put on and proceed with the sinking, keeping the dip end of the shaft in advance with the cutting, thus causing the water

to lie into the rose of the pumps, which keeps the remainder of the shaft bottom dry. In cutting through hard rock, lifting-shots are bored in the centre of the shaft bottom, in the double-handed system of boring, *i.e.*, one of the men striking and the other guiding the juniper. The holes being bored in a slanting position, taking no more of a lift than the experienced eye of the leading sinker knows the charge will manage. The side and corner shots are afterwards plugged off in the single-handed system, *i.e.*, each man striking and turning his own juniper. A heavy lift can sometimes be got with the boring machine, where a back support can be got, without much trouble. Where the metals are of a soft nature, this is secured commonly with 9″ × 3″ batons, end and side bars, morticed into each other at the corners and strengthened by corner rockings, each set of barring being tightly wedged behind and perfectly square and uniform. A plumb line hanging from the top of the shaft guides its vertical position all the way down. Care must be taken when wedging the barring, for if the pressure from behind fall unequally on any part of it, it will bag out into the shaft and probably break. A mid-wall of the same dimensions of barring is carried down, which both strengthens the shaft and forms a return for ventilation, and must not be more than 18′ distant from the shaft bottom at any time, this also giving more safety to the men working below during winding operations. When gravel or sand is met with in sinking it is usually secured by driving down piles, 9″ × 3″ × say 10′ or 12′ long, pointed and toped with iron (the heads with iron tops commonly being cut off to square them when secured). A course of piles being driven down all round, the gravel or sand is again excavated, and another tier of piles is again driven down inside the former tier, and so on, until the hard metal is again reached. In some extensive shafts cast-iron tubbing is used when a running sand is met with, which consists of a number of segments of plates, bolted together with a thin deal lining between each joint, tier after tier is put on as the sand is excavated, until the hard metal is reached. All joints being thrown off line with each other "vertically." A hole being in each plate to free the pressure until secured, when they are cautiously plugged from bottom to top. If necessary, water lodgements are made in the shaft, according to the depth, to divide the lift of water in the pipes, instead of one long lift from bottom to top. Sufficient rings being also cut in the shaft, with water guides, to direct the water from the sides of the shaft to the lodgements. When the mineral seam is reached, pass direct down for 12′ or 14′ and form the sump for the water to accumulate for the pumps. In breaking away the "door-heads," put a scaffold in the shaft, at the level of the mineral bed, and break away on the broadside of the shaft. A large roomy lodgement for water should be made at once and connected to the sump.

UP-SHAFT CUTTING.

WHEN the workings of a pit are considerably extended, an up-shaft is sometimes cut from a lower to a higher seam, sometimes for ventilation, and sometimes to run mineral from the top seam to the lower, to be conveyed along the engine haulage road to the pit bot-

tom. In cutting an up-shaft for air it is generally of the small single form. The shot holes are mostly bored by the boring machine, which clears itself of the borings. Small corner shots only, being afterwards plugged off by the junipers. Side stays being driven in every 3½′ or so, and a scaffold of loose planks laid across, which are lifted to the sides when blasting, and then to the stays above when required. A temporary partition being carried up for ventilation. A frame with a drum is erected on the top seam, and if of the single form, a cage and back-balance weight is put on. The cage descending with the full load takes up the weight, which is sufficient to run up the cage with the empty tub. The double cage system being run in a similar manner. A bottomer is required at the lower seam, and a man at an efficient brake at the top seam regulates the motion of the cages in lowering.

PUMPING.

IN course of sinking when the kettle or barrel used for raising the stuff, is unable to keep the water down sufficiently, to allow the sinkers to work with freedom, the pump is put on. The pipes being hung on tackle of sufficient strength and quality, and always securely fixed, by buntons or stays running across the shaft at regular intervals, and again by collars and slip blocks, to prevent the pipes from slipping, or shaking, when the pump is in operation. Pipes of various lengths, are added at the top when required, short lengths being superseded by longer ones, until a 9′ length is permanently put on. "The Bucket Lift" being the most simple, is *generally used, except in* deep, and heavy watered pits. The bottom pipe has a rose-head for straining the water, preventing small chips of wood, &c., from getting into the seats of the clack and bucket valves and hindering them in their action. The holes in the rose-head being not more than ¾″ diameter, the pipe being commonly jointed to the clack valve piece, or perhaps a length between if necessary. The clack valve is a retaining flap, allowing the water to pass up freely on the upward stroke, and holding it on the downward stroke of the bucket. The working barrel is next added, then the bucket door piece, which like the clack valve piece, is provided with a strong iron door, facing out into the shaft and hung on a chain, from a snug on the pipe above, thus giving access to the valves inside, and in changing the buckets, from either door, when required. The ordinary pipes in 9′ lengths being next added to the surface. Having the working barrel larger in the bore than the ordinary pipes, is a common error, for the pipes should always be wide enough to allow the bucket to be drawn to the surface if required. The bucket is sometimes mounted with a gutta percha cup, but more commonly with a leather one. When the bucket begins the upward stroke, its valve immediately closes, by the weight of the column of water it lifts up the pipes, causing a vacuum to take place underneath, and the atmospheric pressure forcing the water in the sump up the pipes to fill the vacuum space, if the distance be not more than say 30′, which should always be as much less as possible. When the downward stroke takes place, the clack valve immediately closes, and retains the column of water in turn; the bucket valve opening and allowing the wate

to pass through as it decends, and so on every stroke. Clack door, bucket door, and pipe flange joints are made with wrot iron rings $\frac{1}{8}''$ thick × $1''$ or $1\frac{1}{4}''$ broad, lapped with woollen strips and soaked in boiling tallow. The force pump being mostly used in deep or heavy watered pits is a cast iron plunger attached to the bottom end of the pump rods, which are *not inside* of the column of pipes, as in the "bucket lift," but works down into a cast iron cylinder through a stuffing gland, forcing the water up the main column of pipes to the surface, and on the return or upward stroke of the plunger, the water in the main column of pipes is held by a retaining valve, and a vacuum being caused by the plunger rising out of the cylinder, the water rising up the pipes from the sump by the atmospheric pressure to fill the vacuum space, when it is again retained by a valve between it and the rose at the bottom of the pipes, on the return of the plunger on the downward direction. The rods and plunger counter-balancing the water in the main column of pipes to the surface, in this system of pumping is much easier on the machinery which can afford to work a heavier column of water, besides being a much safer and cheaper method.

WINDING.

WINDING is the means employed in raising the material from the pit bottom up the shaft to the surface, an item on the list of mining subjects, which has of late been receiving much well deserved attention, all appliances in connection therewith being greatly improved, especially for the safety in raising and lowering the workmen. When the shaft has been sunk for a few fathoms with the windlass, it very soon becomes tedious work, and is discontinued to be superseded by steam. The engine and boilers are fitted up, and the pit-head frame erected, the pumps are also put on if necessary, and all put into proper sinking order. If speedy winding be not intended, the most common rope used is the flat hemp "Tow," which is hung over a cast iron pulley with double flanges, to guide the rope. The pulley being secure fixed on the top of the pit-head frame. The hemp rope being of a pliable nature works on much smaller pulley than an iron wire rope would allow. One rope only being used as long as the sinking exists, but as soon as the "door-heads" of the mineral seam is broken away, the slides are fixed in the shafts, then the second rope is hung on and both cages employed. The rope or "tow" is fixed on the surface to the "pirns" which are cast iron discs, provided with wooden or (sometimes iron) arms or horns, to prevent the rope from slipping off when running. The pins being properly keyed on a shaft parallel to the engine driving shaft, but on a much slower motion. The pump shaft being also lying parallel to, but on the opposite side of the engine driving shaft, and also on a much slower motion. The pump shaft being nearest the pit mouth, and the pirn shaft having the preference of being behind the engine shaft, so that the weight of the cages, &c., would be sufficient to keep it in gear, instead of drawing it out of gear, should the keying slip. Both pump and pirn shafts being arranged so that they can be easily made to work separately or together. According to the C.M.R.A., each engine used for raising and lowering

persons, &c., must be fitted with an efficient brake, and be also provided with a suitable indicator, to show the position of the cages in the shaft. The cylindrical or common egg-end boilers being mostly used in this system of winding must also be fitted with proper steam and water gauges and safety valve, according to the C.M.R.A. The more modern inventions in winding-machinery, however, in all their details, are now largely employed in most of the principal mining districts almost everywhere. At some collieries where the pits are deep and the output large, instead of the common cylindrical or egg-end boilers they employ the Cornish single-flued boiler, or the Lancashire double-flued boiler, and the Babcock & Wilcox Company are making rapid strides in this direction, with their high-class quick steam raising boilers. Steel boiler plates being used in many instances where a high working pressure is required. The engines, too, for such work, are got up on the coupled horizontal type, of the best class of workmanship of modern engineers, embracing all the latest improvements in valve and reversing gear, &c. The winding drum of large diameter being situated in the engine house, between the engines in front and in full view of the engineman, and being keyed on the engine crank shaft on the first motion, thus commanding a high rate of speed to the cages in the shaft when winding; and, as iron or steel wire ropes are used in such systems of winding, it is necessary that both the drum and the pulleys on the top of the pit-head frame be of large diameter, so as to give as slow a curve as possible to the wire rope in coiling and passing over the pulleys on the top, which are generally of the large "spider" make, being light and easily run.

HAULAGE.

HAULAGE in mines is the conveying of the mineral from the working faces to the pit bottom and the returning of the empty tubs again to the working faces to be re-filled. In pits, having the advantage of a fair dip and rise of the metals, and well situated to the dip boundary of the mineral field, the haulage and draining of the rise workings of water are easy enough matters with gravity in their favour. The self-acting inclined plane is a common system of utilising the power of gravity from a higher to a lower level in underground haulage. A double track of rails being laid in the plane, at the head of which is laid cast-iron plates for slewing the tubs to one or other of the tracks as required. A drum or wheel being also fixed at the upper end, which along with the lower end has the gradient lessened to ease the starting and stopping of the run of tubs. A wire rope or chain passing round the drum or wheel and coupled to the run of loaded tubs, which are held by slip blocks at the head of the plane, and the other end of the rope or chain being attached to the empty run of tubs at the foot of the plane, and on the signal being given from the lower to the upper end, the slip blocks are sprung, when the run of loaded tubs are allowed to steadily descend the incline, bringing the empty run of tubs from the lower to the upper end of the plane, the speed of which is regulated by the person in charge of the drum or wheel, which is fitted with a suitable and efficient brake. Where a large portion of the output has to be brought from the dip workings of a pit, mechanical force has to be resorted to, which is mostly a small steam

engine situated on the surface. If the "dook" leaves the lye at the pit bottom and has sufficient dip and rise, then the simplest and cheapest system of haulage, under the circumstances, is the single rope. This rope being led from the drum of a small steam engine on the surface over a pulley at the mouth of the shaft, going down round another pulley at the bottom of the shaft and led in to the head of the "dook," where pulleys are again erected as required. The end of the rope is attached to the empty run of tubs, which must be of sufficient weight to draw out the rope from the drum, which is detached from the engine on the downward run, the rope, however, being kept tight by the brake. Care must be taken here to have the rope well boxed in and properly secured all the way down the shaft, so that no slack may fall out and interfere with the cage when winding. The rope must also be well secured by a sheath over the pulleys, keeping it constantly in the groove on the downward run, for if allowed to come off them, and run on the pulley spindle it is liable to damage, but more particularly if the engine be started with the full run of tubs, and the rope drawn for some distance over the pulley spindle it will be rendered almost useless, for when the strain is taken off it will curl up like a spiral spring and cause much trouble and difficulty, always afterwards keeping it on the pulley on the downward run. Rollers must be be placed between the rails, at sufficient distances as required, to save the rope and protect the sleepers, and must be constantly examined and lubricated. "The Endless Rope" and "Tail Rope" systems of haulage are generally adopted in "levels." The former being an endless wire rope running from the engine drum on the surface, down the shaft and into the bye at the working faces, round a pulley, and back out and up the shaft again to the drum pulleys of course; being erected at the top and bottom of the shaft, and sufficient guide rollers fixed all the way, where necessary, to lessen the friction and save tear and wear. The rope being kept tight by a weight, with pulleys hanging on it, between two upright pulleys, immediately on the drum paying out. A bogie loaded with iron, commonly couplings, chains, &c., and provided with a grip clutch, wrought with a screw, runs in front, the loaded tubs being coupled thereto and the rope running between the rails, near to the pavement is caught or released, with this grip clutch at will by the guard, who rides on the boggie, in charge of the run. The rope in this system of haulage, running constantly during the working hours, only stopping and restarting at intervals, when the workmen below are unable to give a constant supply of loaded tubs, and on the engineman on the surface receiving signals from the bye at the working faces to that effect. The "Tail Rope" system of haulage is also often used in levels, but two drums are required on the surface instead of one. Two separate ropes are also used in this case, a heavy rope for hauling out the full run of tubs from the working faces to the pit bottom, and a rope of a smaller size, passing in and round a pulley, near to the working faces, and back out to the bye at the pit bottom, each of the two ropes having a separate drum connected to the engine on the surface, and both drums being provided with independent clutches, by which they can be fixed or thrown loose at

the will of the engineman in charge· The smaller or Tail Ropes being hauled in, draws the empty run of tubs from the bye at the pit bottom into the bye at the working faces, the larger or hauling rope being drawn in behind the empty tubs, its drum on the surface being throw out of gear, from the engine, with only as much strain on it from the brake as keep the rope tight, and on being reversed the loaded run, brings the tail rope out with it again, and so on.

SIGNALLING.

TO keep pace with, and meet the requirements of the greatly advanced systems of underground haulage, the signalling from the working faces, &c., to the surface has also been receiving due attention, the most modern appliance being the electric bell, which consists of two electric wires, running from the bye at the working faces to the engine-house on the surface, where the electric battery with bell is fixed. The wires being only 3″ or 4″ apart from each other can be easily operated on at any part of the haulage road, by connecting or simply pressing the two wires together, which immediately acts on the bell, and ceases just as quickly on the wires being again disconnected. This is repeated as often at a time as the signal agreed upon requires. The wires being fixed underground to props driven up at regular distances, or to crowns overhead if more convenient. Sometimes the wires are fixed with common iron staples, with only a lapping of gutta percha between them and the wires, as an insulator; but latterly, and more properly, with *small* earhtenware insulating cups, *made for the purpose.* The battery being always disconnected when not in actual use, to save waste and expense in re-charging. The wires and battery being examined and tested every morning before starting work, and a report made at once, by *any* of the workmen, if during working hours they are supposed to be defective.

TIMBERING.

TIMBERING is the securing with wood the working faces, drawing roads, air-courses, and all dangerous parts of the roof underground. This can be best explained however under given circumstances, for what might be suitably adopted in one instance, could not be always applied to advantage, and for every part to be secured it must depend greatly on the experience and ingenuity of the workman about to do it, or the person to whose direction he works by. In stoop and room workings where the roof and pavement are of an ordinary hard nature, it is usual to drive up a prop of from 4″ to 8″ diameter according to the height of the seam with a good sound lid on top, the perpendicular of the prop to be at right angles to the dip and rise of the workings. Where a main road runs alongside of the wall and the roof metals of a brittle nature, the end of a crown is sometimes "dooked" into the wall close up to the roof, and a prop driven up to the other end of the crown, which is afterwards tightly wedged at the dook hole, the sets being as close or as far apart from each other as may be required. If the road be in the centre of the working room, or if the wall-side be seamy or soft and not to be relied on, then a prop must be applied to both ends of the "crown," and if a

double road be meant, then a prop at each end and one in the centre of the crown must be adopted, the thickness, &c., to be determined on by the person in charge. In main drawing roads, a strap of wood 3″ or 4″ broad by 1″ or 1¼″ thick is sometimes run along and nailed to the upright legs about 2′ or so from the pavement, this steadies and protects the legs from being torn out by a run of tubs leaving the rails, perhaps when running at a high rate of speed. In securing a dangerous hole in the roof where a fall has occurred, crowns and legs are set up as before stated, then filled up, crossed and recrossed with old props, old tramway and railway sleepers, cuttings of legs, old crowns, &c., drawn from the old workings and laid aside for this purpose to serve in like cases of emergency. Some of the stones are then put back up on the top of this old latticed wood, and then the remainder or as much as possible of the hole above tightly stowed up with dirt and small rubbish. In timbering longwall workings, a row of single props are put up in line a short distance back from the working face as required, and the face buildings being afterwards raised and well packed immediately behind them, the props are driven out again to be re-set, and drawn again and again as long as they remain fresh and sound.

VENTILATION.

VENTILATION in mines is such a wide and varied subject that it would in itself fill a book of no mean dimensions, and it would be altogether out of place to enter into it here at any great length. In briefly touching on the outlines of it however, a few practical hints may be of some service to whom it may concern. To ventilate the workings of a mine is to impart into it a constant supply of pure air, this usually is effected by the drawing out of all the impure air, and naturally enough the fresh pure air of the atmosphere rushes down the shaft and in to the workings to fill its place. In all mines a quantity of various gases is more or less given off, which is often both highly poisonous in breathing and dangerous in the extreme in being ignited. An air course, making a complete circuit from the surface down the shaft and conducted round the workings and back to the surface again, is necessary to ventilate the workings of a pit, and in some mines the natural heat of the workings, &c., will at once start an air current which is termed natural ventilation. This system however, cannot at any time be relied on, as much depends on the temperature of the atmosphere in causing the air to travel underground. If the upcast and downcast shafts be of unequal depths, then in winter, when the air of the atmosphere is colder and heavier than the air in the workings of a mine, the shallow shaft will take the down current, and the deeper shaft will be the upcast, the difference in weight of the two colums of air being the motive power, the cold air of the short downcast shaft being nearest to the level of the workings, and the weight of which overbalances the long column of light, warm, expanded air in the upcast shaft, causing a constant current of air to move through the workings as long as the temperature of the atmosphere remains unaltered. But in summer when the atmosphere becomes warmer and lighter than the air in the mine, the shallow shaft then becomes the upcast, being then the

lightest of the two columns of air. Seeing then that this system of ventilation is so uncertain, artificial contrivances have to be resorted to. The furnace, which is on the former principle as in winter, the shallow shaft is chosen as the downcast, and the longer or deeper shaft the upcast, thus giving a greater heating column and therefore more power to the furnace, which is built near to the botttom of the upcast shaft, this greatly assisting the natural heat of the mine to throw off the equilibrium between the two columns of air; and the furnace being always kept heated up gives a constant motive power, and giving good results in deep, dry, and non-fiery mines. The principal ventilator of modern days is the "Fan," which is a wheel of large diameter, situated on the surface near to the top of the upcast shaft, and fitted with blades somewhat similar to the paddle wheel of a steamer, this wheel is encased in a strong sheet-iron cover with an outlet opening up into the atmosphere. The mouth of the upcast shaft is covered over with an air-tight passage leading in to the broad-side of the fan wheel, which is driven round at a high velocity, being on the first motion of a steam engine, thus drawing all the impure air out of the workings below, which is being constantly supplied by fresh pure air from the downcast shaft. It is of the utmost importance, however, that all air-courses be as sound and efficient as possible, so that the air be not allowed to escape from the indrift to the outdrift before reaching the working faces, as the air will certainly take the shortest route and escape through the buildings, &c., if not properly stopped up. All air courses should also be as uniform in size and as evenly built as possible, *for where a narrow* part or a ragged built wall exists it increases the velocity of the air current at the narrow part, and greatly increasing the friction all round, thus seriously retarding the ventilating powers employed.

EXAMINING THE WORKINGS

ACCORDING to the C.M.R.A. the workings of every mine must be carefully examined every morning by a thoroughly competent person acting as fireman with the safety lamp before work begins for the day, if only one shift of workmen are employed; and again once at least during the day when the workmen are present, and immediately before the starting of another lot of workmen, if more than one shift be in operation during the same day. In inspecting the workings of a mine, especially if explosive gas has been found on former occasions, the fireman must proceed slowly along the air-courses and working faces, minutely and carefully examine all likely corners and high parts of the roof where explosive gas could accumulate, taking due precaution to avoid swinging of the safety lamp when travelling the workings and air-courses, and always moving in the same direction as the air current, carrying the safety lamp well down to the pavement, and only when at a standstill raising the lamp slowly towards the roof to examine it, and if gas be found the lamp must be handled with much masterly care and skill to prevent an explosion; no person being allowed to approach until the gas is entirely swept away into the return air-course, and therefore rendered harmless. If the lamp suddenly expires when carrying it near to the pavement, then carbolic acid gas, which is sometimes called "choke," or black damp, is present,

which is highly poisonous in breathing, and must therefore be also lifted and scattered into the return airway before any of the workmen be admitted; and not until the workings are reported to be clear of gas and all safe are the workmen allowed to proceed to their respective working place. The result of such inspection must be duly entered into the report book which is kept at all mines for this purpose, and signed by the person making the same. For round numbers the specific gravity of atmospheric air being taken at 2, that of curburetted hydrogen gas, or fire-damp, which is the explosive gas, is 1; and carbonic acid gas, or black-damp, is 3; it will then be seen that the explosive gas is one-half lighter than the atmospheric air, which accounts for it being always found next the roof, and black-damp being one-half heavier than atmospheric air, being always lying near the pavement.

MODES OF WORKING.

WHEN a coal or other mineral seam is reached, it must then be determined by what method it is to be wrought, and this mainly depends on the thickness of the seam itself, and the nature of the metals forming the roof and pavement. "Stoop and room" is best adapted for, say, a thick seam of clean coal, with an ordinary good roof and pavement, and is wrought as follows:—The seam is broken away off the broadside of the shaft on both sides, at from 12 to 16' wide, and well secured with sound efficient timber, this forming the pit bottom, which is driven in this width a sufficient distance to form a proper bye or bye-road for the loaded and empty tubs. The pavement of the pit bottom is fitted with cast-iron plates for slewing about the tubs in any direction. The levels are started away and driven in almost dead level, only bearing as much to the rise as prevents the water from lying, this is to gain as much of the workings to the rise as possible, and it gives a good main drawing road. When the levels are driven in about 25 yards on each side, break away the headings to the rise, and when up with the headings to a distance of 25 yards, run a narrow drift across and meet in the centre in line with the shaft. The air current being before this, led in by brattice cloth or thin deal boards which can now be removed, as a circuit is now formed for an air course. This circuit always extending as the workings go in, for as soon as one working room is wrought through into another, the former one is stopped up. When in driving a level, a down step is met with which throws say the coal seam down in front, then bare off the step and carefully secure the roof at the slip. The roof metals being then in front, the direction of the level must be gradually turned to the use of the metals, cutting in through them until the coal head appears in the pavement of the level, and when the full height of the coal seam is won, return to the former direction and proceed as before. When an upthrow appears in front of a level, turn gradually towards the dip, cutting through the pavement metals which are now in front, until the bottom of the coal appears in the roof of the level, and when the seam is again won, the level proceeds in its former direction. Longwall is a mode of working that can be best wrought to advantage in a thin seam of ironstone, or a thin coal seam with

a free holing, giving good stowing, or where the roof or pavement would yield good brushing to build the waste workings. The brushing being taken from the roof or pavement metals, or sometimes both, as the case may be, serves the double purpose of both heightening the drawing roads and securing them, and the air-courses with buildings erected with the stones got in brushing, the small loose dirt being well stowed in between the buildings, and all must be tightly and securely packed from pavement to roof, and at times when sufficient stowing cannot be got to accomplish this all the way across from one drawing road to another, a cundy or spare part may be left in the centre of the waste between two working places and back from the drawing roads, which can be widened out or drawn in as required to suit the stowage obtained. The advantages of this mode of working are, *First*—The workmen are able to put out a larger "darg," as it is easier wrought when the weight comes on the working faces. *Second*—A greater proportion of round coal is got than by the "stoop and room" method. *Third*—It is easier ventilated. *Fourth*—Less timber is required as the props are drawn from the front of the buildings after they are erected to the roof. In breaking away the workings in this method the pit bottom and bottom stoops are formed in the same way as in stoop and room, as far as the levels and headings are concerned, until the circuit is cut round, forming the air-course, then a cundy is cut from the levels on both sides of the pit to the centre heading which forms a half circle, and the mineral is wrought away in abreast from level to level which constitutes the rise workings. The same operation is gone through to the dip, the "dook" taking the place of the heading in this instance, thus a complete circle of working faces is formed round the shaft, and as the workings advance in and the circle of working faces widening and increasing in number more workmen are engaged from time to time, as required, until the boundary is reached. This mode works to advantage when a pit has most of its workings to the rise, as the stowing is easiest done down hill, and the face buildings hold much better than in "dook" workings, which is always the most difficult and expensive part to work underground.

MECHANICS.

MECHANICS is the science by which we arrive at the proper dimensions of machinery required in the different processes, for instance—When we get the quantity of water met with in the mine, we can measure it and ascertain the quantity in gallons per hour that would require to be raised to keep the mine clear, we can then ask makers of pumps to give us estimates for pumps to deliver this quantity of water per hour. Then we know the output of mineral per day which we expect to get, and we design winding engines capable of raising this quantity, and order boilers of sufficient capacity to supply both winding and pumping engines. It is by this science that we arrive at all the different strains that our mechanism is likely to be subjected to and the necessary strength to make the different parts to overcome them. This is a subject, however, that is so wide and varied, that it cannot well be entered into here, having such a vast amount of rules and formulæ relating to Mining.

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MINING

A Journal devoted to the interests of Mining.

No. 10. Vol. I. APRIL 6, 1893. FORTNIGHTLY ONE PENNY

MINING NEWS IN GENERAL.

A HUGE COB OF COAL.—Recently an enormous cob of cannel coal, from the Abram Collieries, Wigan, arrived by train at the Alexandra Dock, Liverpool, for shipment to Boston in the steamer "Philadelphian." It is said to be the largest block of coal ever dug from the earth, and weighs over 12 tons. In getting this cob to the surface many men have been employed, and it took nine months to hew it out of the seam. It is said to have cost £1,000—about £83 per ton. When raised the cob was enclosed in a case of planks, the weight of cob and case being 13 tons 11 cwt. It arrived safely at the Alexandra Dock, and its shipment was witnessed by a large crowd of people. It was placed on board the "Philadelphian" by means of ropes and chains attached to four pulley purchase blocks with a 6in. wire rope span. As a precaution against the masts giving way under the great strain of the lifting gear attached to them preventive guys were placed fore and aft. The power was supplied by a steam winch on board the vessel. The time occupied in shipping the cob was only thirty minutes. From Boston the coal will be conveyed by train to Chicago for the World's Fair.

There have also just been shipped from Liverpool several large blocks of rock salt from the Cheshire salt district. Some of them are skilfully carved into figures representing a cow and dairymaid milking, "Lot's Wife," and "Liberty."

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The depression in the Coal Trade in South Wales is becoming more and more alarming. Notices were served on Saturday last at a number of collieries in the Rhondda Valley and Monmouthshire, terminating contracts at the end of 28 days. There are already about 3,000 men out of work, and this number seems likely to be doubled.

THE COAL DISCOVERIES IN DOVER.—The work of sinking a shaft to enable the coal measures discovered on the South-Eastern Company's land, near Dover, to be worked has commenced. The shaft is about 17ft. in diameter. According to Mr. Brady, the Channel Tunnel Company's engineer, the depth of coal measures now proved at Dover amounts to 782 feet, and the proportion of coal is one foot in thickness to every 48·9 feet of strata passed through. The coal, as far as can be ascertained by boring, is uniformly good, pure, and clean throughout the seams. Mr. Brady estimates the probable yield or annual output from one double-pit colliery, provided with the best modern plant and machinery, at 450,000 tons per annum. He sets the cost of working, including royalty, at 6s. 6d. a ton in the present seams, and considers that the selling price at the colliery might be taken at 7s. 3d. per ton, for good, clean, bright coal.

***

BOYCOTTING A WORKMAN'S ORGAN.—Mr. Arthur Gilbertson, proprietor of the Pontardawe Tinplate Works, has had differences with the organ of the tinplate workmen in South Wales, with the result that the following remarkable notice has been posted in the works:—"Notice.—My attention has been called to further remarks in the *Industrial World*, which are untrue about myself. I will not allow this scandalous paper to come into my works; and I will dismiss any person that will bring it on my premises.—ARTHUR GILBERTSON." The notice has excited much adverse comment among the workmen.

***

The question now being asked is "How long is this great depression of trade going to continue?" Every week brings news of further reductions of output, less employment for the men, and of a few dismissals on an extensive scale. It is reported that many workmen are sorely distressed as to how they are going to support their families. It is a problem that can scarcely be solved.

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EXAMINATION QUESTION.

In reply to several readers for a sketch of the two Picks (Science and Art Examination Elementary Stage, 1892.)

The above are manufactured by the **HARDY PATENT PICK CO., Sheffield.**

ANSWERS TO CORRESPONDENTS.

Yorkshire Miner. — The best advice we can give you would be to take a course of Correspondence Lessons by post from T. A. Southern, Derby.

R. Davidson (Chester-le-Street). —Many thanks for well-wishes. Glad you like "Mining" so much.

Americus (Leeds).—1.—Yes. 2. —No, we have not any.

Exam. (Wigan).—1.—The Examination you mention is in May. 2—Collins' metal mining. 3—S. James, on Ventilation.

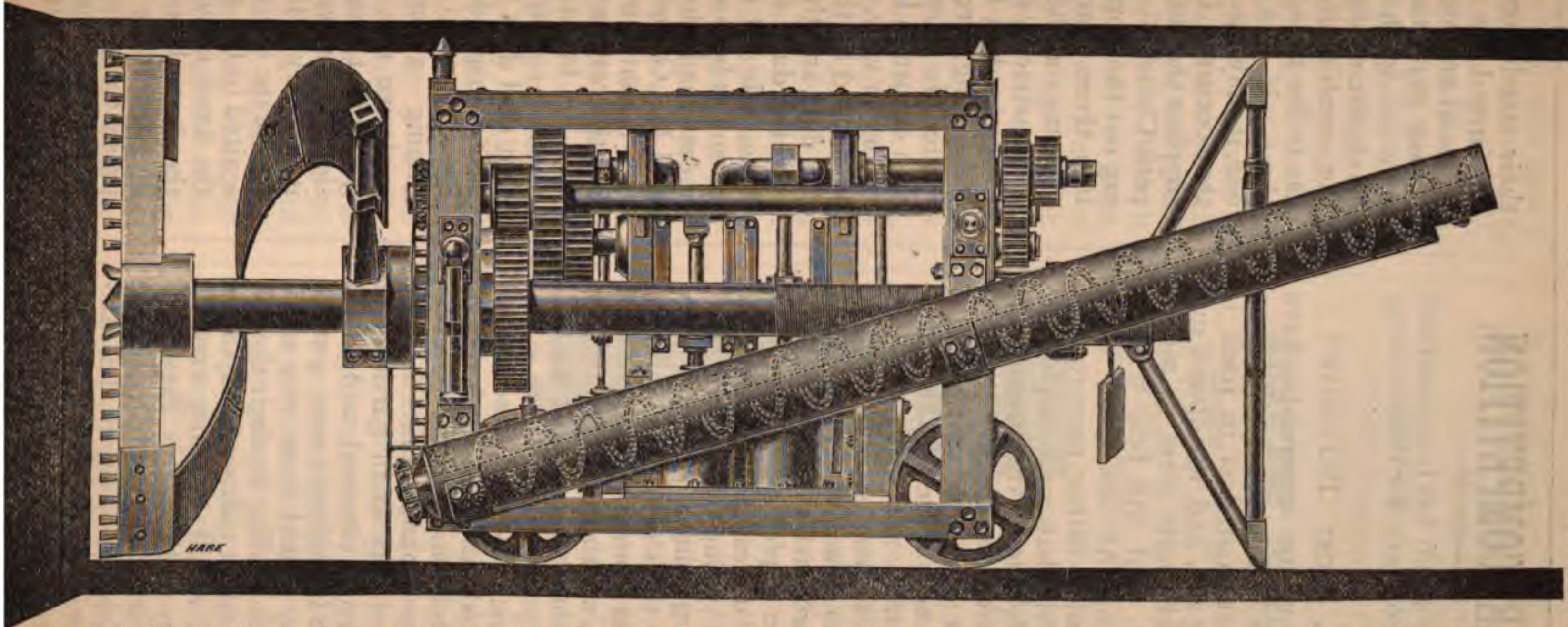
Unsuccessful (Bedlington).—Glad you are satisfied with our decision. The Silver Medal Competition was a big success.

Ex-Miner (Abram).—Yes, 'Mining' should be bought for 1d. We cannot understand why you are charged double.

METHODS OF WORKING COAL.

CHAPTER (V.)

BELOW we give a sketch of **STANLEY BROS., Nuneaton,** latest Gold Medal Coal Heading Machine, and known as the 'Full-cut.'



This machine has been especially designed for rapid driving—it is invaluable where it is necessary to get new workings opened with all possible speed, as by its use the necessary headings would be driven and a good output obtained in about one-eighth the time otherwise occupied; this shows for itself to our readers the great benefit to be derived from its use. It is usually worked by compressed air, which acts as a ventilating agent, bratticing, etc., being avoided.

ARTICLE COMPETITION.

The prize of 2/6 has been awarded to G. W. SCOUGALL, for the following article :—

IS COAL DUST EXPLOSIVE ?

A great many arguments have taken place amongst scientific men as to whether coal dust in itself is explosive or not, and the claims put forth by each party seem to me to sound well, and will bear a deep investigation. At one time, when explosions were rather numerous, it was thought that such explosions were entirely due to the presence of gas alone, but further investigation proved that gas could not exist at the point where some of the explosions occurred, and as a result of these researches, scientific men were led to study the nature and explosive properties of coal dust, as some of the explosions occurred in the main intakes, where coal dust existed, it being deposited there during the transit of the coal from the face to the shaft. The late Mr. Atkinson, in company with another gentleman, set to work to find if it was possible for coal dust to take any active part in forming an explosive mixture. They procured several boxes of coal dust and analysed it, and by their microscopic observations, they found that it was composed of very small particles of stone, coal and charcoal, and that if those three ingredients were put together, they would form very small cells, and according to their theory, these cells might contain an explosive gas, which would instantly explode if ignited by a light, this they considered, would be a pure coal dust explosion (that is to say if the mixture was ignited). Well, Mr. Editor, at this point I beg to differ from their conclusion. If cells were at all formed by the uniting of coal, charcoal and stone, and thereby enclosing gas in them, and an explosion occurred by the ignition of this gas, surely the explosion would occur by the combination of the dust and gas in the cells, and not by the dust alone. If this theory is a correct one, it may account for the explosion that occurred in the hopper which supplies the coke ovens at Brancepeth Colliery. Six men were cleaning out the hopper, which is divided into three compartments, and were cleaning out the dust from the upper compartment, and throwing it down to the landing below, where the men were using torches. These torches ignited the dust, and a violent explosion occurred, but still, keeping their theory in view, the explosion would be caused by the gas in the cells of the dust and the dust combined, and not by dust alone. At the same time, I do not say that coal dust is harmless because numerous experiments made by Sir Frederick Abel and Mr. Galloway have proved that it is a contributing agent in extending the results of an explosion, and also it takes an active part in creating an explosion. We all know that coal dust is inflammable, and is easily suspended in the air, and if ignited, might rush to places containing a small percentage of explosive gas, and by igniting that gas, might produce a violent explosion, hence, we can plainly see that it is a very active agent in assisting to create an explosion. If gas is ignited in the presence of coal dust, the flame is fed with fuel from the the dust, thus causing its extension, and according to my reasoning, the presence of coal dust in a mine should have the careful consideration of the manager, seeing that it works

hand in hand with explosive gases. I may mention that a safety lamp will not detect less than 2½ per cent. of gas, and a place containing less than this quantity might be considered safe, but if we are to be led by such men as Sir Frederick Abel and Mr. Galloway, who say that if from 1 to 2 per cent. of gas is present in a working place, where fine coal dust is deposited, then we have a highly dangerous mixture, and such a place would be very unsafe if naked lights were taken into it. I think it will not be out of place here to mention that there are two kinds of dust, namely, fine or top dust, which deposits itself on all timbers, supporting the roof, and coarse or bottom dust, which is found on the floor of mines. The top dust is more dangerous than bottom dust, on account of its fineness, making it more easy to raise, and I fear, when watering the roads of a mine, this top dust is not taken into consideration, as some people think that by watering the floor of a mine, it prevents the dust from collecting on the cross timbers, and they think rightly too, so far as the bottom dust is concerned, but at the same time dust can be deposited near the roof, apart from it being raised from the floor. When the coals are being hauled to the shaft, they are very much shaken, and the dust thus formed, comes in contact with the ingoing air, and is carried out of the tubs by it, and divides itself, as it were, the fine particles passing to the tops of cross bars, as I said before, and the coarser material is deposited on the bottom, thus we can see that by watering the mine floors, we do not altogether reduce the danger of coal dust being suspended in the air. I hope some of your readers will call my attention to any errrors or misunderstandings that I may have made.

G. W. Scougall,
Bell's Place,
Bedlington, Northumberland.

(We invite discussion upon the above).
Editor of "Mining."

ANSWERS TO QUESTIONS.

Question 2—Sketch and explain the Water Gauge and its use, giving examples?

Answer to Question 2—

The Water Gauge is an instrument made of glass tubing bent in the form of the letter U, one end is open to the atmosphere and the other is connected with a pipe of small diameter which passes into the return air of the mine. Its use is to measure the pressure (above the atmospheric pressure) which produces the ventilation. On the water gauge is a graduated scale of inches and tenths, by means of which an exact measure of the pressure is obtained. The centrifugal force of the fan tends to produce a vacuum or causes an inferior pressure in the fan race, &c.; seeing one end of the gauge is open to this inferior pressure, the superior pressure of the atmosphere forces the water up one limb of the gauge. Now, every inch of W. G. = 5·2lbs. per square foot. The total pressure producing ventilation is found by multiplying the height of W. G. by 5·2; the product of these multiplied by the area of the airway in square feet, will give

the total pressure in lbs., thus what will be the total pressure producing ventilation in an airway 6′ high and 8′ broad, height of W.G. = 1·5.

Answer: $1·5 \times 5·2 \times 6 \times 8 = 372·4$lbs.

The pressure per square foot will be found by multiplying the height of the W.G. by 5·2, as in the example above the pressure per square foot would $= 1·5 \times 5·2 = 7·8$lbs.

ISAAC SMITH,
13, Hardwick Place,
Hunslet Carr,
Leeds.

Question 3—Describe the method of underground haulage by the endless chain system, what are its advantages and disadvantages?

Answer to Question 3—

The endless chain system of haulage is like many other systems of haulage for having advantages and disadvantages, no doubt it obtains more of the former than what it does of the latter. The endless chain is something similar to the endless rope system of working, only the former is a chain where the latter is a rope. Large pulleys and sheaves are required, some of which are erected in a vertical position, whilst others are in a horizontal position, as the case may be. Then there are jockeys or forks required for connecting the tub to the endless chain; some of the jockeys or forks which are used in this system of haulage, are fixed on the end of the tub and some on the side. I would prefer the jockey or fork to be at the end of the tub instead of the side, because I think when the jockey or fork is at the end of the tub, it travels steadier and moves in a straighter line than it would do if the jockey or fork was at the side. Now, for one or two of the *disadvantages* which are connected with the above system—in the first place the large expense which is caused in the laying out and commencing of this system. Secondly—If a man or a boy happened with an accident, such as getting fast to a tub or to the chain, or any of the sheaves or pullies, there would be a considerable amount of damage done before the motion of the chain could be stopped; although I am allowing an immediate plan for signalling to be used, such as electric bells. Now I will give one case that came under my notice—I saw a man oiling the three big pulleys which were erected in an horizontal position on a vertical shaft, one of these pulleys was a fixture and the other two was moveable, so that they might be put out and into gear if it was necessary, and whilst he was busy oiling, his jacket sleeve got fast between the chain and the pulley, and was drawn a considerable way in before the engine was stopped. Now, its advantages—it can convey a large quantity of coal from the various flats to the shaft. There is a large pulley at each end of the various roads from which coal is to be conveyed, it has to be double all the way, one way for the full tub and one for the empty tub. All the tubs travel underneath the chain, whilst a fork or jockey is stuck in at the end of the tub, and is sticking up 9′′ or 1′ above the top of the tub and fixed into a link of the chain, which travels at about two or four miles an hour. There is not the tear and wear attached to it as there is attached to the main and tail rope system of haulage, it does away with a good deal of horses, and does more work,

and the rollyway lasts a good deal longer before it needs to be repaired. The endless chain does not only work on level roadways, but works where there is heavy inclinations in the mine; it can be worked where curvature cannot be avoided, so that we all may see at once that the endless chain or rope system of haulage is a good and economical system.

ROBERT WIGHT,
Percy's Yard,
Bedlington.

*THOS. BEST, Railway Street,
Tow Law, Co. Durham.

Question 4—How is Slate Mined in North Wales?

Answer to Question 4—

In slate mining different methods are adopted. In some cases the slate is mined by quarry work, and this is worked in benches or caunchs, care being taken to find the natural joints to get out large blocks from which the slates can be properly cut along the plains of cleavage. There is another method where drifts are driven in the sides of the hills, either beneath or above the bed of slate which has to be worked. The bed of slate is always worked to the rise, and worked off by either overhand or underhand caunchs, a method which is similar to that of the broken work in pillar or stall coal working, where the place advances at right angles to the cleavage plains in a long open face, the slates being peeled off.

R. DAVIDSON,
12, Grange Villa,
near Chester-le-St.,
Durham.

Question 5—At what rate would it be necessary to work a 15″ pump, 6′ stroke, to keep down a flow of 250 gallons of water per minute in a shaft 280 yards deep, and what H.P. will be required?

Answer to Question 5—

First find what the barrel will hold which is $15 \times 15 \times \cdot 034 \times 6 = 45 \cdot 9$ gallons, and divide the plan of water by 45·9 will give the rate the pumps should run, which is $\frac{250}{45 \cdot 9} = 5 \cdot 446$ strokes per minute, practically 5·5 strokes. H.P. is found as follows $\frac{250 \times 10 \times 280 \times 3}{33{,}000 \times \cdot 5} = 127 \cdot 27$ H.P. of engine, using a modulus of ·5.

JAMES WEIR,
18, Sunnyside Terrace,
Coatbridge, N.B.

*JNO. GRAY, Oliver's Buildings,
Glebe Row, Bedlington.

Question 6—What kind and size of Fan would you put down for 90,000 cubic feet of air per minute. Give speed, size of engine, cylinder and stroke, and how would you test the fan's efficiency?

Answer to Question 6—

Before choosing a fan, one question of vital importance should occur to us, viz:—which fan will give the most useful effect; so, under these conditions, I think preference should be given to the Capell, as I have known it to give as far as 70·20 per cent. useful work. For the above quantity of air, I would put down a Capell Fan of about 12′ diameter and 10′ wide. A pair of coupled condensing engines, 20″ diameter (working with expansion), having a 3′ stroke, with a speed of 50 revolutions per minute, with an indicated horse-power of

113. To test the fan's efficiency, the amount of pressure must be determined by the water gauge. Suppose the water gauge to read 3″, an inch of water-gauge equals a pressure of 5·2 lbs. on the square foot, then 3 inches will equal 15·6 on the square foot. Now let the sectional area of the main intake airway be equal to 100′, and let the velocity equal 15′ per second, then 100 × 15 × 60 = 90,000 cubic feet of air circulating per minute, therefore

$$\frac{90{,}000 \times 15{\cdot}6}{33{,}000} = 42{\cdot}5 \text{ H.P.}$$

Notwithstanding the above plant far exceeds the present requirements, but it is better to provide for some future time, when the workings may be extended, as the first cost is not much increased.

James Riddle,
Delight Colliery,
Dipton,
Co. Durham.

Question 6—What kind and size of Fan would you put down for 90,000 cubic feet of air per minute. Give speed, size of engine, cylinder and stroke, and how would you test the fan's efficiency ?

Answer to Question 6—

I would prefer the Guibal Fan, as it gives a good efficiency with a low water gauge. The following rule will give the diameter of it—If we take a Guibal Fan of 20′ in diameter for 30,000 cubic feet of air per minute, and at 40 revolutions per minute, and increase its diameter 1′ for every additional 7,000 cubic feet of air per minute, the result will be the diameter required—

$$\frac{90{,}000-30{,}000}{7{,}000} = \frac{60{,}000}{7{,}000} = 9' \text{ nearly}$$

9 + 20 = 29′ diameter of fan.
Revolutions = 30 per minute.
Water Gauge 1·5″
The H.P. in the air is equal to—

$$\frac{1{\cdot}5 \times 5{\cdot}2 \times 90{,}000}{33{,}000} = 21{\cdot}27 \text{ H.P.}$$

The efficiency of this fan is 57 per cent., therefore the H.P. of engines to drive it will be—

$$\frac{21{\cdot}27 \times 100}{57} = 37{\cdot}3 \text{ H.P.}$$

The H.P. × 33,000 and divided by piston speed and by pressure of steam × ·7854 and extract square root = the diameter of cylinder.

$$\sqrt{\frac{37{\cdot}3 \times 33{,}000}{30 \times 2{\cdot}5 \times 2 \times {\cdot}7854}} = 17'' \text{ diameter.}$$

Total diameter of fan 29′
,, Revolutions ,, 30′
,, Length of stroke (engine) 2·5′
,, Water gauge 1·5″
,, H.P. of engine 37·3
,, Diameter of cylinder 17″
,, Efficiency of fan 57 per cent.

If we multiply the H.P. in the air by 100, and divide by H.P. of the engine, the answer will be the fan's efficiency or useful work done by it—

$$\frac{21{\cdot}27 \times 100}{37{\cdot}3} = 57 \text{ per cent. of useful}$$

work done by the fan.

G. W. Scougall,
Bell's Place,
Bedlington,
Northumberland.

Question 7—How would you proceed to repair an old shaft, and how would you ventilate it ?

Answer to Question 7—

If the shaft has for some time been abandoned, it would be necessary to make the preliminary examination of it with the greatest caution, as to the extent of the repairs required, or as to the presence of noxious gas, for as is often the case in old shafts, carbonic acid

gas, often called choke damp, may be found in large quantities, which is a very deadly poison. There are various ways of proving the presence of this gas, two of which I will mention. The first is to lower a lighted lamp into the shaft; if it is there the light will immediately die out, for this gas is fatal to both light and life. The second is to lower a bucket filled with lime-water; if, when it is drawn up, the water is covered with a film, and becomes turbid on stirring, it is also a sure sign that it is there, and something must be done either to clear it out or keep it back. If the shaft is connected with old workings, and the gas coming from them, it might be advisable to fill up the shaft above the level of the workings, which would have a tendency to keep it back. Sand or fine ashes would be best for this, as they would go closer than anything else. If this was effective, we could now proceed with the repairs. If the sides of the shaft were very bad, it might be advisable to fill it up with cinders, and begin as if sinking a new shaft, but the usual method is with scaffolding, though great care must be exercised in fixing the scaffolds. This is the plan I would adopt: I would cut needle holes into the side of the shaft 6″ or 7″ deep, and if it was a 16′ rectangular, which is a very common size and shape in Scotland, I put four needles or bearers in the length of the shaft buntons, 4″ × 5″ would do very well for needles or bearers on which to lay the scaffolding, which may be of ordinary baton wood, and would be very safe, and would be capable of carrying the débris which may fall from the sides of the shaft, and from which it may be filled into kibbles and sent to the *surface*. I would put in the first scaffold from 9′ to 12′ from the surface, and work up, and as one set of old timber was taken out, I would always have a new set ready to put in, for if the sides were left long unsupported, they might give way and cause a deal of trouble, and I would continue fixing scaffolds at the above distance from each ether, always working up, and so on till I reached the bottom. If no midwall was to be put in, it would be necessary to put in wall plates and stretchers 4′ to 5′ apart, on to which brattice cloth may be tacked. If this did not ventilate it, I would hang a fire-lamp in one end of the shaft, with a wire rope or chain from a windlass, which would allow of it being lowered as the works proceed, and which would rarify the air and cause a current.

JOHN MURRAY,
Gatehead,
via Kilmarnock,
Ayrshire, Scotland.

*THOS. BEST, Railway Street,
Tow Law, Co. Durham.

Question 8—Give the simplest methods you know to extract the "square root" and "cube root" of any number—extract the square root and cube root of 7854?

Answer to Question 8—

168	$\sqrt[2]{7854}$ (88·62
	64
1766	1454
	1344
17722	11000
	10596
17724	40400
	35444
	495600

Answer to the square root 88·62.

39 =	300	$\sqrt[3]{7854}$ (19·87
	351	1
	651×9	6854
	81	5859
578	108300	995000
	4624	903392
	112924×8	91608000
	64	82619803
5947	11761200	8988197
	41629	
	11802829×7	

Answer to the cube root 19·87.

ROBERT WIGHT,
Percy's Yard,
Bedlington.

Question 9—State fully the duties of a Certificated Manager under the C.M.R.A. of 1887 ?

Answer to Question 9—

In answering a question of this kind, I think competitors should not quote the Act word for word as it is stated, because the said answer cannot be original as required in the conditions laid down, but should state in simple language what he thinks the Act requires the Manager to do. My reasoning of the matter is as follows:—1st:—Every Manager must be responsible for the control of the mine he has in charge, and must daily inspect it (unless it is so inspected by the under Manager), and must also be a holder of a first-class certificate. 2nd: — He must see that the requirements of the Act are strictly carried out both by the workmen and the officials under him, as well as attending to such requirements himself. 3rd:—He must place a copy of the Act in some suitable place, and in such a position as to be seen and read by the workmen (the copy is generally put on the pit head). 4th:—If a workman applies for a copy of the Abstract and Special Rules at the office, such copy must be given to him free; the Manager not being allowed to charge for them. The Manager must have such copies at the office to be ready when applied for. 5th:—Whenever printed notices are required, whether in or about a mine, such as danger boards or signal codes, he must see that they are put in their proper places, and when such notices are disfigured or rendered impossible to be read, he shall at once renew them. 6th:—When any place is reported to him to be unsafe, either from the nature of the roof or sides, or from the presence of gas, he must attend to and remedy the defect. 7th:—The Manager must have a constant supply of air circulating in the mine, so that if gas is given off, it may be rendered harmless by dilution, whether the gas given off may be inflammable or not. 8th:—Where safety-lamps are used the Manager must carry out that Clause of the Act requiring such lamps to be properly constructed and protected, so that they may be safely carried against the current of air ordinarily passing through the mine, and also see that they are kept in thorough repair, and cleaned and securely locked when about to be used; the Manager in this case must appoint a competent person to examine and lock all safety lamps before giving them to the workmen, the person so examining the lamps, must as directed by the Manager, give orders as to how such lamps are to be used. 9th:—He must not allow any person, unless authorised by him, to have in his possession any in[illegible] ment that might be used for ope

lamps (such as lamp keys). —He must not allow any one to have in his possession any ty of powder exceeding 5 lbs., powder to be enclosed in a to reduce the danger of it ing, also such person must not nore than 5 lbs. in use at any ne or place, and the Manager iot allow it to be stored in any he shall not allow his work- ɔ use any gear or instruments :e made of iron (solely) for the se of preparing the blast; such specially the pricker and tam- ust be either made of copper or or tipped with them. 11th:— iall not allow any shot to be n a place containing inflam- gas in such quantities as is ed to produce an explosion, r shall he allow a shot to be n a dry and dusty mine, unless ace is watered for a radius of ds from one shot hole, or un- ie explosive is so mechanically ged with water, that such an sive cannot ignite gas or dust. —The Manager must attend to quirements of the Act relating ing against old waste, refuge and the condition they must ɔt in, together with their depths ieir distance apart under various ns of haulage. If horses or ponies ed, he must not allow the animals ne in contact with the timber ough insufficient height many ɔf roof no doubt would occur timber was allowed to be worn gh by this cause. 13th:—The ger must have all old shafts workings securely fenced, and keep a correct plan of the pre- mine now working, and must send to the present Secretary of a correct plan of the workings, ing the boundaries of a mine if bandoned. Such plan must be drawn to a scale of not less than 25" to the mile, such plan must be accompanied by the workings of a mine in relation to the surface, the rate of dip of the strata, or the depth of the shaft. 14th:—The Manager also must see that the Act is carried out concerning the engineering department connected with the mine, such as requiring the machinery being securely fenced off, sufficient roads into the engine houses, &c. 15th:—The Manager must not employ any boy in or about a mine, unless he is satisfied that such boy is of the age required by the Act, and must not employ any boy for a longer time than is specified by the Act. The Manager must also allow sufficient time (stated by the Act) for meals. 16th:—The Manager must report any loss of life or personal injury to any workman, within 24 hours, to the inspector of mines for the district. 17th:—At the end of each year, the Manager must send to such inspector a full report of all persons employed above and below ground, according to the requirements of the Act, also quantity of mineral drawn, and also a true report as to the mode of ventilation, number splits, quantity of air in each split, &c.

G. W. Scougall,
Bells Place,
Bedlington,
Northumberland.

Question 10—What gases are found in mines, and what are their chemical composition ?

Answer to Question 10—

The principal gases met with in mines are Fire damp, Carbonic acid gas, Hydrogen, Sulphide and Carbonic oxide, and their composition is as follows:—*Fire damp* is a mixture of several gases, its principal

constituent being Marsh gas, C.H.4, and is composed of 1 atom of carbon combined with 4 atoms of Hydrogen. Its molecular weight is 16. *Carbonic Acid gas* is composed of 1 atom of Carbon and 2 atoms of Oxygen. Formula CO_2 Molecular weight 44. It has neither colour nor smell, but an acid taste. It is found in large quantities amongst the gases occluded in some coals, and is produced by the respiration of men and animals, and by lamps and candles, and by the oxidation of the coal and other substances. It extinguishes lights, and is fatal to animal life. *Hydrogen Sulphide* is composed of 2 atoms of Hydrogen and 1 atom Sulphur. Formula H_2S, Molecular weight, 34. It is a colourless gas, but has a strong smell, not unlike that of rotten eggs. It is generated in small quantities in coal mines, especially in old worked portions partly filled with water and not ventilated. It does not support combustion, but is itself inflammable, and when diluted with ten times its volume of air, it produces sickness, and loss of sensation. *Carbonic Oxide* is composed of 1 atom of Carbon combined with 1 atom of Oxygen. Formula CO, Molecular weight 28. This gas is the result of imperfect combustion, and is produced by the combustion of gunpowder. It has neither colour, taste, nor smell, but is poisonous if 1 % in the air, if breathed for long producing fatal results. It does not support combustion, but burns with a blue flame, forming CO_2

J. WATSON,
56, Diana Street, Newcastle.

We will give a uniform reward of 1s. for the best original answers to the following questions. All competitions are subject to the rules given below:—

1st—All envelopes must be marked "COMPETITION"

2nd—To be written on one side of the paper only.

3rd—Correct postal name and address must be sent.

4th—They must reach us by 25th of April, 1893.

Question 1—Sketch and explain the use of the Moss Box in the Kind and Chaudron system of Sinking.

Question 2—Describe the Yorkshire Coal Field.

Question 3—How is Rock-Salt worked ?

Question 4—What is the system known as single and double-stall methods of working coal ?

Question 5—What is the "Fleuss" apparatus for using in dangerous gases ?

Question 6—How would you ventilate a downbrow place filled with stythe or C.O.^{2}

Question 7—When would you prefer the Bood and Pillar system of working ?

Question 8—If the hauling engine-house caught on fire down below in the downcast, what would you do if in charge ?

QUERIES BY READERS.

In answer to your correspondent, R.R., asking which of the two faults, namely, an upthrow or downthrow, gives off most gas (C.H.4.) I cannot say that I am experienced in the matter, being only a theorist. I therefore let law and reason lead me. In my opinion, a downthrow gives off most gas. At a downthrow the level is driven through the fault above the seam, and when we consider the ascensional properties of Carburetted hydrogen, we can conceive that the gas pent up in the seam below will ascend into the level, while that on the rise will ascend the fissures of the earth and pass to the surface.

JOHN

MINING

A Journal devoted to the interests of Mining.

No. 11. Vol. I. April 20, 1893. FORTNIGHTLY ONE PENNY

MINING NEWS IN GENERAL.

Fatality at Moston.—On Monday an inquest was held at the Moston Town Hall relative to the death of a miner named Richardson who was killed by a prop coming down as he was descending an incline. The deputy overman named Donnelly said he had been told the road needed repairing, and that there were props caught by passing wagons. The prop which he had said required repairing was not the one which came down the brow.—By the jury: The wagon would pass a prop nine inches away from the rail, and he had always thought that the prop which fell was twelve inches away from the rail.—By Mr. J. Butler: He had examined the scene of the accident indirectly on the following morning, and found that the manholes, which would hold half a dozen men, were accessible.—Mr. Saint, the Government Inspector, said he had examined the mine since the accident and found the road in good condition, and the manholes more than required by law.—The jury agreed to a verdict of "Accidental death." A correspondent complains that though the death took place at noon his family did not know of that until ten o'clock the next day when they went to inquire about him. Nothing was known at the colliery at nine o'clock that morning. An attempt was made to question the doctor on the subject, but the coroner would not permit this, stating that that was not the subject of the enquiry, and the matter must be dealt with by the Infirmary authorities.

***

We regret to have to record this week another terrible fatality in South Wales, by which from fifty to sixty lives have been sacrificed. On Tuesday a fire broke out in one of the pits of the Great Western Colliery, Pontypridd, and up to Wednesday night there was hope that the loss of life would be comparatively small. But about Two o'clock this (Thursday) morning the fact was made known that fifty-three *bodies* had been discovered by the various exploring parties, and the fatility, therefore, involves a large number of families in a sad bereavement.

***

Fined for Opening a Lamp.—At the Merthyr Police Court, on Monday, Daniel Bowen, collier, was fined £4 and costs, or a month with hard labour, for unlocking his lamp, and for having an unlocked lamp in his possession on the 6th inst.

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The St. Just Mining Disaster—Manager Heavily Fined.—At West Penwith, on Saturday, the Magistrates imposed a fine of £15 and costs upon Captain Boyne, Manager of the Wheal Owles Mine, in which twenty men were drowned on January 10. The defendant was prosecuted by the Government Inspector of Mines for failing to keep an accurate mine plan complete to within six months of the disaster.

***

A further attempted settlement of the dock strike at Hull has proved abortive. On Saturday the men forwarded through the Mayor their own propositions—namely, that they were prepared to accept a Labour Bureau, to work with non-unionists provided they were such of their own free will and no inducements or preference of employment were offered, and that they would not object to foremen and shipping clerks leaving the union if they were allowed to organise associations of their own. The Shipping Federation Committee rejected the terms, and the situation is unaltered.

***

News from Belgium is to the effect that the strike is spreading. It is computed that at least 100,000 men have left work, and further accessions to the ranks of the strikers are expected.

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St. Helens Miners Joining the Union.—The circular issued by Mr. Thomas Glover, Miners' Agent, St. Helens, a week ago appealing to the men outside the union to join at once has had a good effect, and about 200 men joined the federation last week.

ARTICLE COMPETITION.

The prize of 2/6 has been awarded to JOHN GRAY, Glebe Row, Bedlington, Northumberland.

IMPROVEMENTS IN THE TRANSIT OF COAL UNDERGROUND.

WHEN we consider the transit of coal underground from the early history of coal mining up to the present time, we recognize the great improvements that have been made in haulage. In the beginning of coal mining coal was carried in baskets and barrows—the coal was filled into a basket at the face, and then wheeled by a barrow to the flat or shaft, sometimes the barrow was unloaded so far out-bye and the baskets carried out to the shaft, and if there was no mechanical means for raising the basket they were carried up ladders to the surface; but as the demand for coal increased, it necessitated better appliances for the conveyance of coal, the baskets were made larger, and took the name of corves, and instead of one corve being carried on a barrow, two or more were carried on a bogie, the bogies running to the shaft carried more than those running from the flat to the face, the corves at set places were lifted (by means of a crane) from the small bogies, and placed on the large ones. At other times, where a fault caused an obstruction in the road, the coal was teemed down a spout and then re-filled; when the corves reached the shaft they were raised up the shaft to the surface by means of a rope connected to an engine, whim, or gin, or some other mechanical contrivance. But as demands further increased the corves and bogies became inadequate, then came the tubs, the coal being filled into the tubs at the face, and then putting or hurried to the flat by men or lads—at this station the tubs were coupled to each other and taken in sets to another landing, or the shaft, by ponies or horses, but hand-putting being very heavy work, except where the roads are level, ponies were introduced into the mines for putting, but it was found that hauling by ponies and horses was very expensive, then the gradient of the hauling roads was taken advantage of, and self-acting inclines where used, which consists of a rope passing round a sheave or drum provided with a friction brake at the top of the incline, one end of the rope attached to the hind end of the full-set, and the other end to the fore end of the empty set, but this could only be worked where the gradient was sufficient for the full tubs to pull the empties up the incline, and where the gradient is dipping in bye the tubs have to be hauled by horses, but a horse going down the incline with an empty set can be made to help the horse up the incline with a full set, by means of a rope passing round a wheel at the out-bye end of the incline—one end of the rope connected to the hind end of the empty set, and the other end to the limbers of the horse connected to the full set; if then a large amount of coal is to be hauled, and the gradient high enough for the empties to pull a rope after them, and the rope geared to an engine, it can be used for hauling a set of full tubs out-bye, but where the empty tubs will not drag the rope in bye, a tail rope, in addition to the hauling rope, is used for pulling the empty set and hauling rope in bye. Each rope runs on a separate drum, but both drums run on one

shaft, and can be fixed to the shaft and made to revolve with the shaft by means of a clutch on the shaft fitting into a groove in the drum, and either of the drums can be put in and out of gear at pleasure; each drum has a brake, the object of the brake is to keep the front rope tight while the set is descending any place, or the tubs might run over the rope and damage it. The main rope runs on one drum and the tail rope off the other, passing round a wheel at the in-bye end of the plane, the main rope is carried on the plane by rollers fixed in the centre of the road, about 10 yards apart, and the tail, which is twice the length of the plane, is carried on rollers and sheaves fixed by the side of the plane or roof, and partly by the main rope rollers, where more than one district is worked by this system; each district must have a separate tail rope; each district tail rope may run out to the shaft, or for the connections to be made or broken at the junctions; with this system of haulage a single way is only needed, and requires to be kept in good order, as the engine runs at a very high speed, and in this case if the gradient out-bye would enable the full tubs to pull the tail rope after them, the hauling rope might be dispensed with. If the roads are wide and in good order, the endless rope or chain will be the best system to have. This system consists of double roads—the rope passes round a pulley (the pulley to be of such a make as to hinder the rope from slipping) connected to an engine, also round a sheave fitted on a shaft at the junction, and for every district there is a separate sheave on the same shaft, the shaft and sheaves are so constructed that they can be thrown in and out of gear at will by a lever; each sheave has a groove down it which fits upon clutches on the shaft for the purpose of gearing it with the shaft, the tubs are connected to the rope by jockeys fixed on the top or by the side of the tubs; the tubs can either be run in sets or separately, about 20 yards apart—the speed is usually from three to five miles an hour. A much less engine is required for this system than the main and tail rope system. I have often thought that the main and tail rope system of haulage could be very much improved by having two hauling ropes instead of one, and for the tail rope to have no connection with the engine, just to pass round a wheel at the ends of the plane. By this improvement an empty set can be pulled in-bye when a full set is being hauled out; while with the old method two journeys have to be made for one set of tubs, but this improvement would necessitate double way, or three lines of rails, and double way at the meetings; if then there were only three lines of rails, each district would have to be the same length, so that the set would always pass at meetings.

We have also awarded a Prize of 2/6 to JNO. FOX, Norton Cranes, near Cannock, Staffordshire.

THE North Staffordshire Coalfield, though of smaller area than that of South Staffordshire, has vastly greater capabilities. The strata are about four times as thick with twice the thickness of workable coal, and instead of being bounded on each side by enormous faults, which places the coal measures at almost unapproachable depths, the coal measures of North Staffordshire dip under the permian and triassic

rocks along a line of many at the south-western border of the coalfield, and under these formations coal may be obtained at some future day. Moreover, there are none of these protusions of igneous rocks which have produced such injury to the coal beds of South Staffordshire, as at Wolverhampton, etc. This coalfield has the shape of a triangle, with its apex to the north at the base of Congleton Edge; the eastern side is formed of millstone grit, and the western of new red sandstone or permian strata. Along the south the coal measures are overlaid by permian marls and sandstones, and these strata run far up into the heart of the coalfield by Newcastle along the line of a great fault which ranges north-west towards Talk-o'-th'-Hill succession of strata in the North Staffordshire coalfield. Permian rocks, red and purple sandstones, marls and cornstones (with plants), strata slightly unconformable to the coal measures, thickness 600 feet. Coal measures—1st, upper brown sandstones, greenish conglomerate (like the volcanic ashes of South Staffordshire); 2nd, middle sandstone shales with ironstone, and a few seams of coal; 3rd, lower black shales and flags, with Wetley Moor thin seams of coals, millstone grit, coarse grits, black shales, etc., with marine fossils, carboniferous limestone. Succession of coal seams:—

1.	Peacock Coal	6′	6″
	Strata	20′	0″
2.	Spendcroft Coal......	3′	9″
	Strata......	121′	0″
3.	Great Row Coal......	8′	0″
	Strata..............	71′	0″
4.	Cannel Row Coal ...	5′	0″
	Strata..............	54′	0″
5.	Wood Mine Coal ...	2′	0″
	Strata..............	29′	0″
6.	Winghay Coal	4′	6″
	Strata......	377′	0″
7.	Rowhurst	8′	9″
	Strata..............		
8.	Burntwood...........	5′	0″
	Strata..............	68′	0″
9.	Golden Twist.........	3′	6″
	Strata..............	486′	0″
10.	Mossfield	4′	7″
	Strata..............	30′	0″
11.	Coal	3′	0″
12.	Birches Coal	4′	6″
	Strata..............	300′	0″
13.	Cufoot Coal	6′	0″
14.	Bowling Alley	4′	6″

There are twenty-two seams which are marketable and workable, and fifteen other seams that are of no value. The faults of this coalfield are not numerous, except in the neighbourhood of Talk-o'-th'-Hill, there are several very large dislocations, one of which forms the boundary of the coalfield along its north-western edge; it runs along the western base of Congleton Edge, and to the west of Talk-o'-th'-Hill, throwing down the new red marl of the Cheshire basin. This dislocation is more than 500 yards, and its direction is north, north-east. Another fault, with a downthrow on the east of nearly 350 yards, passes by Newcastle and the east of Hanchurch; and at Hunford there is a third, a parallel line, with a downthrow of 600′; on the same side, east of Longton, the coalfield is bounded by a large fault, which was visible near the entrance to the railway tunnel when it was being made; it throws in the new red sandstone on the east side. The North Staffordshire coalfield is of a triangular form with its acute apex to the north and its face to the south, the strata at part of the west side and for almost the whole of the east rest upon elevated ridges of millstone grit. The quantity of coal available, after all deductions, is estimated as follows:

Surface Area.	Tons at a depth not exceeding 5,000 feet.
54,182 acres.	1,788,014,708

Tons at a depth of not exceeding 3,000 feet.
585,185,861

Total at all depths in tons,
4,826,278,593

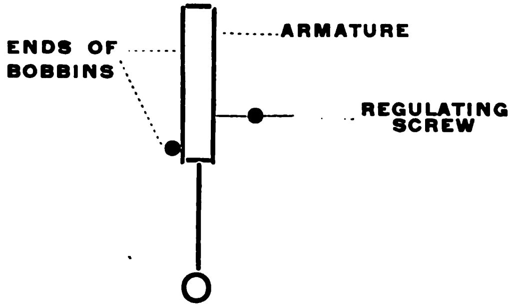
ELECTRICITY RELATING TO MINING.

CHAPTER IV.

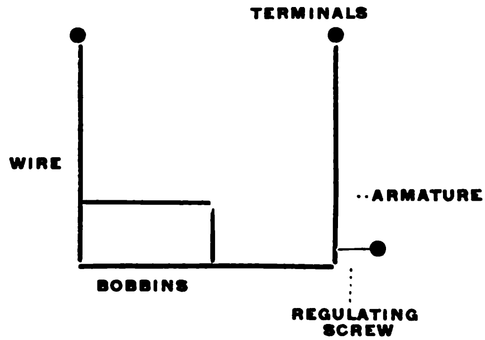
THE above illustration represents the Electric Bell in its completed form, and for those of our readers who are desirous of making one for themselves, we may say that all the articles necessary can be bought from Messrs. J. Davis & Sons, Derby.

The articles necessary are :—Two Bobbins, quarter lb. Cotton-covered Wire, No. 34, B.W.G. (Birmingham Wire Gauge) ; one Bell, one Armature, Rod, and Nob ; two Terminals, one piece of Soft Iron, bent in the form of the letter U.

You commence by winding evenly one layer of wire on the bobbin, and then dip or pour on some hot wax, cover over with a piece of waxed paper and continue until the *two* bobbins are full, then insert the piece of soft iron through the two bobbins, and fasten down to the board (see illustration), fasten the armature down, and let it run along the ends of the bobbins, where the two pieces of soft iron are just through, the armature is the part where the nob is attached, insert the two terminals (for connection to the battery) and also fasten the bell on, then insert the regulating screw and terminal in the following position :—



To fasten up, connect as below :—



In our next we shall describe how the wires are fixed in the mine, and how the connections are made.

TITLE PRIZE.

Owing to the tremendous number of Coupons sent in for this competition, we were obliged to withhold it from our last number.

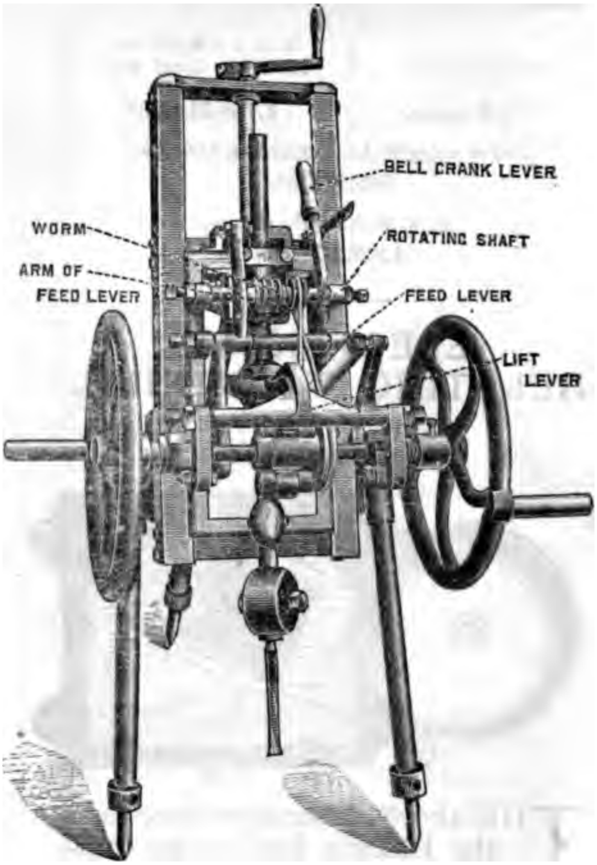
The prize of 2/6 has been awarded to ROBERT STRACHAN, Begg's Yard, High Blantyre, N.B., who suggested a title that has received the most votes.

ANSWERS TO QUESTIONS.

Question 1.—Describe some Drilling Machine for drilling holes during the operation of Sinking?

Answer to Question 1—

A Drilling Machine that has recommended itself for use in sinking pits is the Darlington one, it is a percussive drill; it is constructed on the differential principal, it has no valves, the forward and backward strokes of the piston are affected by the difference in the area of the annular space at the front of the piston, and the area of surface at the back, the intake port is continually open, and when the piston is at the back of its stroke the pressure on the back of the piston having a much greater surface to act on than at the front, the drill strikes to the bottom of the hole and in so doing the piston closes the port admitting compressed air to the back of the piston and opens the exhaust port, the pressure then acting on the annular space at the front of the piston gives the back stroke. The piston to which the drill is secured direct is automatically turned on every stroke by a rack and screw of coarse pitch. The piston carrying the drill is firmly secured to a horizontal bar which is firmly clamped against the sides of the shaft, and the compressed air pipes are carried down the shaft and a connection is made with the machine by means of a flexible hose pipe; the horizontal bar carrying the



machine has a rope or chain attached to it by means of which it can be raised when shots have to be fixed. This drill is very efficient, making about 200 strokes per minute. The above illustration represents a very efficient drill for Sinking, manufactured by **HARDY PATENT PICK CO., Sheffield.**

ANGUS McLELLAN,
99, Knightswood,
Maryhill,
Glasgow.

Question 3.—What is the American methods of Timbering? Give sketches.

Answer to Question 3—

The American method of timbering places in mines where the seams are at a low angle is the same as is adopted in our mines. Ordinary sets of timber, consisting of a plank usually 6′ long and 5″ wide and $2\frac{1}{2}$″ thick, and props are used; where one end of the plank is notched into

the coal only one prop is necessary, but where this is not suitable as is the case when the road is kept in the middle of the place, two props are used, one under each end of the plank, but where the seams are highly inclined and the roof is very bad, quite a different method is adopted and much stronger timber is used. Baulks from 10 to 12″ thick are used, and of varying lengths to suit the width of the place. The method of fixing this timber is as follows:—The baulks have holes cut out at their ends, sufficiently large to allow of the reception of the end of the prop, the baulks are then put up and the props put under them, the top end of the props are fitted into the holes at the end of the baulks, and the bottom ends of the props are put into holes cut in the floor of the seam, and the props are set about 2′ or 2·5′ wider at the bottom than at the top; after the sets are put in position they are firmly wedged by driving wood wedges in between the roof and the top of the baulk, and in cases where the nature of the roof necessitates the set being put in very close, the space between each baulk is lofted with ordinary planks; when the bottom ends of the props are set into the floor they are not forced out by forward pressure.

G. W. Scougall,
Bell's Place,
Bedlington, Northumberland.

Question 4.—Explain the first law of Ventilation? Give examples.

Answer to Question 4—

The first law of Ventilation relates to friction due to rubbing surfaces. The roof, floor and sides of an airway offer a resisting power to the ventilating current, and this law may be explained as follows:—The pressure necessary to overcome friction varies in direct proportion to the rubbing surfaces, because if we increase the rubbing surface of an airway we also increase the friction, and *vice versa*. If we desire to keep the same quantity of air passing through an airway after additional rubbing surface has been added to it and necessitating additional friction, then we must have additional pressure, hence the above law. It is the great study of Mine Managers to reduce as far as possible the friction produced by the air rubbing up against the sides of an airway; if circular airways could be made in mines, having the same sectional area as a square one, then this friction would be very much reduced, as there is less rubbing surface exposed to the air current per square foot of section in a circular airway than there is in a square one, as an example—we shall take an airway 11′ × 6′, which equals an area of 66′ and 1,000 yards long, then the rubbing surface, the perimeter being 11 × 11 × 6 × 6 = 34′, and length 1,000 × 3 = 3,000′, will be 34 × 3,000 = 102,000 square feet; then the rubbing surface per square foot of section will be $\frac{102.000}{66} = 1545·45$ sq. feet. Now take a circular airway with an area of 66 square feet, the diameter will be—

$$\frac{66}{\cdot 7854} = \sqrt{84·03} = 9·16′.$$

The circumference will be 9 × 16 × 3·1416 = 28·77 lineal feet. The rubbing surface per square foot of section will be $\frac{86310}{66} = 1307·72$ square feet. Now in this example we can plainly see that there is more friction in the square airway than there is in the circular one, because there is a larger amount of rubbing surface

in the former than there is in the latter form of airway, the difference being—

Square airway......	102,000	sq. feet of rubbing surface.
Circular ,,	86,310	,, ,,
Or a difference of ...	15,690	,, ,,

Or there is 15⅓ per cent. more rubbing in the square airway than in the circular one, hence $= \frac{15{,}690 \times 100}{102000}$ = 15⅓. Consequently there must be 15⅓ per cent. more friction, and if we add 20,000 cubic feet of air travelling through the circular airway with a water gauge of 1·5″, we must increase the ventilating pressure 15⅓ per cent. if we desire the same amount of air to travel through the square airway. The water gauge will be for square airways $\frac{1{\cdot}5 \times 15{\cdot}3}{100}$ = ·22″ increase, or a water gauge of—

$$\begin{array}{r} 1{\cdot}5 \\ {\cdot}23 \\ \hline 1{\cdot}73'' \end{array}$$

Or the ratio of increase of rubbing surface per square foot of section, is as 1 is to 1·18. Therefore the water will be 1·18×1·5 = 1·7″. Hence we must conclude that the evidence of this example clearly proves that the first law of ventilation is correct and applicable, namely—that the pressure necessary to overcome friction increases or decreases as the extent of rubbing surface increases or decreases.

G. W. Scougall,
Bell's Place,
Bedlington, Northumberland.

* Jno. Gray,
Glebe Row, Bedlington.

Question 5.—Explain the second law of Ventilation? Give examples.

Answer to Question 5—

The second law of Ventilation relates to pressures and velocities, and is stated as follows:—The pressure necessary to overcome friction of the air in mines varies as the squares of the velocities, and the velocities vary as the square roots of the pressures. If we wish to increase the velocity of an air current more power will have to be put into operation, and that power is pressure; and the question is, how is this pressure produced and where does it come from? Well, we must adopt some means to get this additional pressure from the atmospheric air, such as increasing the difference of the weight of the air in the downcast and upcast shafts, or by reducing the atmospheric pressure on the air in the up-cast shaft by means of a fan. But if we increase the velocity we do not increase the pressure proportionately, but the pressure increases as the squares of the velocity. Take as an example the following—If the air current is propelled with a velocity of 10′ per second by a water gauge of 1·5, and we find it necessary to increase the velocity to 14′ per second, what height of water gauge must we have? According to the above law, the water gauge increases as the squares of the velocities.

$$\frac{10^2}{100} \; \frac{14^2}{196} \; \frac{1{\cdot}5}{1{\cdot}5} = 2{\cdot}24'' \text{ of water gauge.}$$

Example (2) If we get a velocity of 14′ per second with a water gauge of 2·94″, what velocity must we expect with a water gauge of 1·5? In this example it is a velocity we want and not a pressure, and the rule is—the velocities vary as the square roots of the pressure. In this example, we shall have a less velocity because we have a reduced pressure $\frac{\sqrt{2{\cdot}94}}{1{\cdot}7146} \; \frac{\sqrt{1{\cdot}5} \; 14}{1{\cdot}2247{\cdot}14}$ = 10′ per second nearly. I have only extracted the square roots to four places of decimals. The same ru-

good for quantities, when the areas and lengths are the same. Example (3) If with a water gauge of 1·5″ we have a quantity of 30,000 cubic feet of air passing, what height will the water gauge be for a quantity 50,000 cubic feet ? $\frac{3^2 \; 5^2 \; 1{\cdot}5}{9 \; 25 \; 1{\cdot}5} = 4{\cdot}1$ inches.

When different airways are under consideration, the quantities vary as the square roots of the resistences inversley. Example (4) If a quantity of air of 40,000 cubic feet is split into two airways both of equal areas, but their lengths are as follows:—A is 1,000 yards long, and B 2,000 yards long, what quantity will pass into each airway ? In this example, the resistance in B is greater than in A, therefore an increased resistance means a reduced quantity, but the quantities in this case do not vary directly as the resistances but as the square roots of resistances. We will take their lengths in yards but not in whole numbers as 1 and 2, but in inverse fractions as $\sqrt{\frac{1}{2}}$ is to $\sqrt{1}$, the square root of a half is $\frac{1}{2} = \sqrt{\cdot 5} = \cdot 223$, and the square root of $\sqrt{1} = 1$. We must also add the fractions together, 1 + ·223 = 1·223, then the quantities in each airway will be 1·223 1 40,000 = 32706·46 cubic feet for A. 1·223 ·223 40,000 $\frac{7293{\cdot}54}{40{,}000{\cdot}00}$ cubic feet for B.

I will give another example showing how quantities are arrived at when airways are different in areas and lengths. If we have two airways, one of them which we will call A, is 6′ high and 10′ wide and 2,000 yards long, and the other one which we will call B, is 5′ high and 9′ wide, and is 3,000 yards long. How much will pass into each airway, if) cubic feet are split into these ? Now the velocities in se will be different, as the areas are different, the velocities vary inversley as the square roots of the resistances per square foot of section, we must find the volocities and multiply them by the areas to find the proportionate quality for each airway. The area of A is 6′ × 10′ = 60 square feet. Rubbing surface is 6 + 6 + 10 + 10 × 2,000 × 3 = 192,000 square feet.

$\frac{60}{192.000} = \sqrt{0{\cdot}0003125} = \cdot 0176$ velocity for A, and to find the quantity, we multiply ·0176 by sectional area of A, which is 60 square feet, therefore ·0176 × 60 = 1·0560 proportionate.

B's area is 9 × 6 = 54 square feet.

Rubbing surface is 9 + 9 + 5 + 5 × 3000 × 3 = 252,000 square feet.

$\frac{54}{252{,}000} = \sqrt{0{\cdot}000176} = \cdot 01334$ proportionate velocity for B, and proportionate quantity = ·01354 × 45 = ·60030, therefore the quantity circulating in each airway will be as follows :—

A $= \frac{1{\cdot}0560 \times 30{,}000}{1{\cdot}65630} = 19126{\cdot}9$ cubic feet per minute.

B $= \frac{\cdot 60030 \times 30{,}000}{1{\cdot}65630} = \frac{10873{\cdot}1}{30000{\cdot}0}$ cubic feet per minute. 1·65630 is got by adding the proportionate quantities together.

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Bell's Place,
Bedlington, Northumberland.

*F. Graham,
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Durham.

Question 6.—Explain the operation of Sinking a Metal Mine Shaft ?

Answer to Question 6—

When sinking a metal mine shaft, the form of shaft, size, lining, etc., depends on various things—such as hardness of strata, cost of timber, walling in the place, the action of the air, water, etc., on the material

with which the shaft is lined. Where the vein is vertical, the shaft is always sunk in it, as after the first ten or twelve fathoms, the ores found in the veinstuff partly pay for the expenditure of sinking. In the old tin mines of Cornwall and North Wales the shafts were 3 or 4′ in length, and only 2½′ in width, but at the present time shafts are made larger, being 8′ by 6′, and where pumping engines and ladders are in the shaft they are 15 or 16′ by 8′. After the shaft has been sunk to a depth of about 6′ feet, strong cross beams are run across the shaft's sides, and either notched into one another or strengthened at the corners by corner pieces of wood. Perpendicular supports are notched into these beams, and the ground between is secured by driving in laths, which answer the same purpose as backing deals in a circular shaft. When the shaft has been sunk 10 fathoms in this manner, horizontal levels are turned away in opposite directions. These levels can be carried to any extent. When the engine shaft is sunk deeper, similar levels are driven out of it every ten fathoms, the shaft always being sunk deeper than the lowest level. The shaft is divided into two divisions by a brattice, one is for the ladders whilst the other is used for drawing the minerals in the kibble. Subsidary shafts are called winzes.

FRANK GRAHAM,
Keeper's Row, Tow Law,
Durham.

Question 7.—What sort of Air Crossings do you prefer? And why? And what is their relative costs.

Answer to Question 7—

The Air Crossing that I prefer is *the one that is* made in the solid *rock when the nature* of the rock will allow it. My reasons are—there will be no brick work for the air to scale through, and none to repair in case of any explosion, as they are not liable to be blown out by an explosive force. I would drive the drift to pass 6′ above the road and for the ripping to rise 6″ in the yard; if then the road was over 6′ high and the crossing 6′ high, I would start the ripping about 25 yards from the road on each side, 12 yards would be driven before the place was in close. Taking the place to be 9′ wide, then as the ripping started at nothing and finished at 6′, the cubic feet taken out for the 12 yards on each side will be $\frac{6 \times 9 \times 12 \times 3}{2} = 972$ cubic feet, and allowing 2½d. per cubic foot, the cost of the first twelve yards will be $2\frac{1}{2} \times 972 = 2{,}430$ pence or £10 2s. 6d., and for both sides it will be £10 2s. 6d. × 2 = £20 5s. Then the road to be crossed is 9′ wide, the crossing will be driven in close for $3 + 12 + 12 = 27$ yards, and allowing 3½d. per cubic foot for drifting, the cost will be $\frac{3\frac{1}{2} \times 9 \times 6 \times 27 \times 3}{12 \times 20} =$ £63 15s. 9d., and the total cost is £63 15s. 9d. + £20 5s. = £84 0s. 9d. If the crossing is made of bricks, then £20 5s. will be spent on ripping, taking the crossing to be 10′ long and 10′ wide, with a semi-circular top, the walls to be 9″ thick, and allowing 6·6 bricks per square foot, and the cost of bricks £1 5s. per thousand and 5s. for lime, and 4d. per square foot for building, the cost of such an air crossing will be $5 \times 3{\cdot}1416 + (1 + 1 \times 10) = 177{\cdot}08$ square feet, then $\frac{177{\cdot}08 \times 6{\cdot}6}{1{,}000} = 1{\cdot}166872$ thousand bricks, and $1{\cdot}166872 \times 25 =$

$$29{\cdot}1718 \text{ s cost of bricks.}$$
$$\frac{177{\cdot}08 \times 4}{12} = 59{\cdot}0266 \text{ s for building.}$$
$$5{\cdot}0000 \text{ s for lime.}$$

93·1984 s

$\frac{93 \cdot 1934}{20}$ + (£20 5s.) = £24 18·1984 s = total cost.

JOHN GRAY,
Oliver's Buildings, Glebe Row,
Bedlington, Northumberland.
* G. W. SCOUGALL,
Bell's Place, Bedlington,

Question 9.—How is Tin, Lead, and Copper found, and how are they prepared for the market?

Answer to Question 9—

Tin, Lead, and Copper ores are found principally in veins associated with different kinds of spar. These veins vary in width from a few inches to several feet, extending sometimes to a great length and depth. Lead ore is found in deposits traversing the Cambrio - Silurian formations and the Carboniferous limestone. Tin and copper ores are found and worked in mineral veins, traversing the formation lying between the Carboniferous formation and the Metamorphic rocks, these, together with the Plutonic rocks, are where the chief deposits of tin and copper are found in the great mining district of Cornwall. These ores are prepared for market in a somewhat similiar manner. They are first spalled and cobbed. If the tinstone contains impurities, such as iron pyrites and mispickel, it is calcined, that is, the tinstone is placed in a retort and heated, when sulphur and arsenic are given off. They are next crushed or stamped. The lead ore, after being sized, is passed through jiggers, whilst the tin and copper, as well as the lead ores, are treated by both round and rotary buddles. The finer slimes may be separated by the Brunton Frame.

FRANK GRAHAM,
Keeper's Row, Tow Law,
Durham.

Question 10.—How is Iron mined?

Answer to Question 10.

Ironstone usually being found stratified, may be worked either by the longwall method, as practised in Staffordshire and elsewhere, or by the bord and pillar as adopted in the Newcastle coalfield. In the longwall method the whole of the iron ore is removed at once. The roof and gateways being supported by packs built of the stone which falls with the ironstone, except in dangerous places where props either of wood or metal are used; being somewhat similar in every respect to the longwall method of working coal. In the bord and pillar method, as practised in Weardale, two working places are driven parallel to each other, called "fore-heads," and connected at intervals by holings or walls, for the purpose of ventilation. Out of these fore-heads bords are turned away 12 yards apart, these bords being 12′ wide and varying in height from 10 to 25′, according to the thickness of the bed. As the workings advance they are connected by walls 7′ high and 6′ wide, forming pillars. The roof is supported by trees, principally of fir, being put in every two yards. They are rounded off to a point at one end, and tapered at the other in a wedge shape. The rounded edge is placed in a hole in the side of the bord near the roof, which has been prepared for it; whilst the other end is driven on to a ledge which should be firm and strong. Where the sides show any signs of weakness, another tree is set vertically underneath to strengthen the support, branches of the trees are placed crossways, close together, in order to keep any small stones from falling on to the heads of the workmen. In the operation of getting the ironstone in the bords, a thickness of 6

is taken out at the top of the bed for a distance of 2 or 3 yards, this always being kept in advance, the remaining portion being taken out behind by underhand stoping, the stone being taken away in wagons. The holes are drilled by hand, one man striking the drill, another turning it round, gunpowder being used for blasting. The pillars are extracted in a similar manner as coal, being taken off in slices or lifts. The trees which support the roof are withdrawn by a hole being bored in one end in which is placed a small charge of dynamite, this shatters one end and causes it to fall. The price paid for getting the mineral is 2s. 2d. per ton.

Frank Graham,
Keeper's Row,
Tow Law,
Durham.

We will give a uniform reward of 1s. for the best original answers to the following questions. All competitions are subject to the rules given below:—

1st—All envelopes must be marked "Competition."

2nd—To be written on one side of the paper only.

3rd—Correct postal name and address must be sent.

4th—They must reach us by 25th of April, 1893.

Question 1—Describe the Capell Fan; what are its advantages?

Question 2—When sinking below the last length of bricking what precaution would you take for the men's safety?

Question 3—What are the Rules referring to self-acting planes?

Question 4—Sketch and describe a dam, capable of resisting a power of 150lbs. per sq. inch, to be put in a tunnel 9' x 6'

Question 5—Sketch, describe, and give relative cost of an air crossing for 50,000 cubic feet per minute.

Question 6—To raise 800 tons per day, give size of cylinders, stroke, diameter of drum, number of revolutions, number and class of boilers. Depth of pit, 370 yards.

Question 7—What cost and size, etc., of hauling engines would you put down to haul 20 tubs of coal of 7cwt. up at brow dipping 1 in 7.

Question 8—Describe the working of the Staffordshire 10 yard seam.

Question 9—Describe the South Wales coal field.

Question 10—What is the system of working known as the "single" and "double stall?"

PRIZES.

We offer a Prize of the "Mining Diploma of Merit" for the best article on "How to prepare for the Managers' Examination."

SECOND SILVER MEDAL Competition.

We offer a Silver Medal for the best articles on any or all the subjects below:—

- Haulage
- A description of any Coalfield.
- Advantages of any method of Timbering.
- What is the best Explosive? Why?
- Why are Lime Cartridges not more generally used?
- Comparative cost of Haulage by Ponies or Power.

The articles must reach us by May 9th, 1893, and are subject to the same conditions as before.

We offer a Prize of 2/6 for the best article on "How does Metal Mining coincide with Coal Mining?"

Printed and Published for the Proprietor by Strowger and Son, Clarence Yard, Wallgate, Wigan.

MINING

A Journal devoted to the interests of Mining.

No. 12. Vol. I. May 4, 1893. FORTNIGHTLY ONE PENNY.

MINING NEWS IN GENERAL.

The Pontypridd Colliery disaster like many others has several sad facts to relate, and during the funerals of the poor fellows that lost their lives, one strikes us as particularly impressive where a father and three sons were buried together, the sons having lost their lives in going back and trying to rescue their father.

***

It is estimated that £12,000 will be required so relieve the sufferings of those that now need support, £1,490 has already been subscribed, the Company having given £500.

***

The Government report of Park Slip disaster has just been issued and may be summed up as follows:—

1st—No torch-lights allowed.

2nd—No keys for lighting lamps to be left hanging about.

3rd—All Safety Lamps to be the property of the Colliery. That colliers must *not* take them home, and a more efficient method of locking be adopted.

4th—That all shots shall be fired by Officials, and that dynamite and gunpowder be prohibited.

5th—That the greatest vigilance be used in the detection of Fire-damp.

6th—That a system of watering the roadways be adopted.

***

Coal is to be well represented at the Chicago World's Fair this year. Tremendous blocks have already arrived, and as the Americans put it "This is to be the best Exhibition of Coal (and Cannel) you ever saw."

***

Models made of the many methods adopted in the working and winning of coal will also be on view, and the greatest care is to be adopted to get them true in every detail.

Photography will also play an important part in making this part of the Exhibition not only attractive but useful.

***

The great depression in the coal trade is gradually getting worse, and many collieries that have worked full time for years are now working three days a week, others only one and two days, while many collieries have already been compelled to close.

***

The trials for alleged embezzlement by four of the German Miners' leaders has just finished, one has been sentenced to six and another to four months imprisonment, while two have been acquitted.

***

It is reported that during boring operations for water on the Earl of Dysart's estate, at Silk Willoughby, a village near Sleaford, Lincolnshire, the workmen penetrated a seam of coal about 27 feet below the surface. The strata varies in thickness from six to twelve inches, and the general opininion is that Coal abounds in the neighbourhood, as a similar bed was recently discovered in an adjoining parish. Steps are being taken to test the quality of it.

***

Captain Quentrall, Government Inspector of Mines at Kimberley, has sent home £103 to the Wheal Owles Relief Fund. This sum was contributed by Cornishmen on the Kimberly Diamond Fields.

***

Much excitement prevailed at the mining village of Craigcefu Park, in the Swansea Valley, in consequence of an alarming accident at Clydach Collieries. As the miners were leaving their work a heavy fall of debris blocked up the return airway, and seriously interfered with the ventilation of the workings. Many of the miners were overpowered by the noxious gases, and others experienced narrow escapes. Exploring parties were immediately organised, and Dr. Hopkins applied restoratives to the men. Had the accident happened early in the day when all the miners were at work, serious disaster would probably have happened.

ARTICLE COMPETITION.

The prize of 2/6 has been awarded to G. W. Scougall, Bell's Place, Bedlington, Northumberland.

Ventilation, its Uses and Benefits.

TO those of your readers who have a more advanced knowledge of the above subject than I have myself, I hope the few remarks that I am about to make will not be offensive. When we speak of ventilation, especially in connection with mining, we are apt sometimes to give more attention to the word itself than to its real meaning, that is to say—when we speak of ventilation, we should have some idea as to the benefits we derive from it if properly attended to, and the injurious or bad affects that we must inevitably encounter if it is neglected. First of all, we all know that the atmosphere is composed of two important gases, namely—oxygen and nitrogen in proportions so mechanically fitted together as to be fit for the use of man. Oxygen gas is not a combustible but a supporter of combustion, and nitrogen is a non-supporter of combustion, but takes a very active part in reducing or diluting the excessive power of oxygen, whereby as I said before, the composition is so well arranged that no change can be made of it so as to give better results; but should other gases be mixed along with it, and if no attention is given to their intrusion, then the bad affects arise. We inhale oxygen which is taken up by our blood and carried to all parts of our body for its support, and at the same time we exhale carbonic acid which is also gathered from our bodies by the blood during its circulation and thrown into the atmosphere, and this continual change must at all times take place to keep us in good health and to enable us to live for a longer period, and at the same time we must observe—that if a reverse state of things occur we will have bad health and finally a much shorter existence. Some people think that if we have our homes completely boxed up and a high temperature maintained, we will have exceptionally good health, at the same time neglecting good pure air to breath. They do not for a moment think that the supply of oxygen that rushes into the rooms when the doors *are* opened becomes exhausted, and that the carbonic acid which is so deleterious to health is greatly on the increase, so much so that oxygen in passing through the lungs is diminished from 21 to 16 per cent. by volume, and carbonic acid is increased from ·04 to 4 per cent.; we may just imagine when we think the matter over seriously, what state the air in such homes will be in if a further and further reduction of oxygen is allowed to take place and carbonic acid allowed to go on accumulating; well, to put it in a very pointed way, we are simply adding fuel to the fire that ought to be extinguished, because we are breathing carbonic acid over and over again. This gas being so dangerous to breathe, and favouring disease as it does is sure to destroy our health and should never be allowed to accumulate, but should be swept away as soon as it is exhaled from our lungs. In order to do this we are confronted with the question—How can we prevent the injurious affects of bad air? I think this can be answered very briefly by saying that we should at all times and in all places have a continual supply of fresh air for foul,

this is termed ventilation. The affects of bad air in our homes also applies to mines, and in fact to all places where people work or live. In our mines the air is made impure not only by gases given off by the coal, but by men and animals, decayed timber, gases resulting from shot firing, lights, &c., but in our Coal Mines' Regulation Act, provision is made calling upon Mine Managers to have a continual current of air sweeping through the mine to dilute and destroy the action of these gases upon our blood and also for the safety of the mines as well. The benefits to be derived from fresh air are very numerous—(1st) It is a health giver and reduces disease. (2nd) It makes our lives happier than it would otherwise be if we lived amongst impure air. (3rd) It enables us to do more work with greater pleasure, and in fact it is one of the chief problems of health. The quantity of air necessary for a man working in the mine is much questioned by mining authorities, and I may mention that if a certain quantity per man was allowed in one mine under suitable conditions, the same quantity might not be suitable for another mine whose conditions are less favourable. Therefore I think it will be out of place here to say what the quantity ought to be per man in a mine, but I think all mine managers will supply the proper amount per man according to the conditions of the mine of which they have charge. I do not wish your readers to think that a hurricane of air should pass round the workings of a mine, because the cure would be as bad as the disease, as the workmen would be subject to colds, but just a sufficient supply to keep them in a healthy state, and to prevent gas from accumulating. Mr. Editor, I would suggest that your readers should study the atmospheric air on which we depend so much for our existence, and the benefits to be derived from their lessons would be incalculable, that is to say—from an intellectual point of view and the reasons for good pure fresh air would at once come before their minds eye, and I think they would at once set to work and inwardly digest the necessity for having good ventilation.

CHEMISTRY RELATING TO MINING.

CHAPTER IV.

IN our last article we briefly described the gases met with in coal mines, with the exception of Carbon Dioxide $C\ O^2$. To produce, we may put a few pieces of marble in a bottle, pour in a little water and Hydrochloric Acid is now poured on, the Carbon Dioxide escaping and may be collected in any convenient vessel. The action that takes place is :—

$$\underset{CaCO^3}{\text{Marble}} + \underset{2\,(H\,Cl)}{\text{Hydrochloric Acid.}} = \underset{Ca\,Cl^2}{\text{Calcic Chloride.}} + \underset{H^2O}{\text{Water.}} + \underset{C\,O^2}{\text{Carbon Dioxide.}}$$

Carbon Dioxide is an odourless, colourless and tasteless gas, will *not* burn or support combustion, and is heavier than air (consequently is found on the floor of mines). It can be condensed to a liquid at a pressure of 36 atmospheres ($36 \times 15 = 540$lbs.) If the pressure is suddenly taken of and the gas allowed to escape, some of it will assume a state almost like snow and having a temperature below zero of 78° C.

The intense cold that Carbon Dioxide gives off while in changing from the the liquid form to the gas

can be shown by the following experiment :—Put a little Mercury in a stoneware pot and lay on it some solid Carbon Dioxide, and pour a little Ether on the whole. Such an intense degree of cold will be produced that the Mercury is frozen into a solid block. Carbon Dioxide has a slightly acid taste when in water, and only slightly turns blue litmus paper red. When pure Carbon is burned in Oxygen, Carbon Dioxide is formed, the following action taking place :—

$$\frac{\text{Carbon} \;+\; \text{Oxygen}}{C \;+\; O} = \frac{\text{Carbon Dioxide}}{C\,O_2}$$

(To be continued).

ELECTRICITY RELATING TO MINING.

Chapter V.

AFTER we have satisfactorily made our Battery and Bell, it only remains for us to connect them together, this can be done in several ways :—1st for Colliery purposes. Staples are driven into props about 6" apart, and the conducting wires (which are usually iron) are connected to them as below :—

The connection being made by pressing the two wires together or having a long nail and laying it to a spring and thus connecting the two wires. They can be bought from **Messrs. DAVIS & SONS, Derby.**

ANSWERS TO QUESTIONS.

Question 1—Sketch and explain the use of the Moss Box in the Kind and Chaudron system of Sinking.

Answer to Question 1—

The use of the Moss Box in the Kind and Chaudron system of sinking is the same in principle as the gland of a steam engine cylinder, the only difference being that in the former case it is used to prevent the escape of water from behind the tubbing above the moss box, and in the latter case it prevents the escape of steam from the cylinder to which it is attached. The moss box is simply a solid ring of cast iron with an outside flange on its lower edge, and is made a little smaller in diameter than the bottom ring of tubbing, so as to allow it to slide within this lower ring which also has an outside flange on its lower edge; the outside of the sliding ring is surrounded with a network of moss (hence the term moss box), and when this box reaches the bed made of it, it remains permanent, but the

Question 2—Describe the Yorkshire Coal Field.

Answer to Question 2—

What is known as the Yorkshire Coalfield includes also Derbyshire and Nottinghamshire too. It extends from Leeds to Nottingham, and is 65 miles long, from 8 to 20 miles broad, and the area exposed is 760 sq. miles. This coalfield dips towards the east when it is over lapped by the lower red sandstone, magnesium, limestone, and the new red sandstone. The seams crop out on the western side and are 16 in number, with a total thickness of 45 feet of coal. The most important seams are: 1st—The top hard seam which is six feet thick in Derbyshire, is increased to nine feet as it passes into Yorkshire, when it takes the name of the Barnsley thick coal. The clod seam is also found in Derbyshire. In South Derbyshire there is a seam known as the Kilburn, it is noted for its splendid household coal. The above seams are worked on the longwall and double-stall method. The thickness of the coal measures—a few miles from the outcrop—about 3,000 feet, but the lower part of them are noted for flagstones and for coal seams having ganister floors.

G. W. SCOUGALL,
Bell's Place,
Bedlington, Northumberland.

Question 3—How is Rock-Salt worked?

Answer to Question 3—

Rock-Salt may be worked by three different methods. (1) Where the rock crops out at the surface or forms a mountain it is quarried. (2) Where it is found in the interior of the earth it is mined on a somewhat similar principle to pillar and stall, large pillars being left to support the roof; or (3) After the shaft is sunk and the bottom made secure, it is flooded with water. The water dissolves the salt. The salt brine is then pumped out of the mine iuto evaporating pans, when the water is evaporated, depositing the salt at the bottom of the pan.

ISAAC SMITH,
13, Hardwick Place,
Hunslet Carr, Leeds.

* R. DAVIDSON,
Grange Villa, Chester-Le-Street.

Question 4—What is the system known as single and double-stall methods of working coal?

Answer to Question 4—

In the single post and stall, narrow bords are driven generally 2 or 3 yards in width, out of which headways are turned away every 30 or 40 yards out of these, bords are turned away about 4 yards in width, leaving pillars from 5 to 8 yards thick. In the double-post and stall, bords are turned away 2 yards wide, leaving 10 yards between for about 6 yards, when they side over 5 yards each, and then takes the 14 yards up together and brings 5 yards each back with them within 6 yards of the headways.

JOHN JOHNSON,
Dyke Row,
Howden-le-Wear,
Co. Durham.

Question 5—What is the "Fleuss" apparatus for using in dangerous gases?

Answer to Question 5—

The "Fleuss" apparatus is a small mechanical contrivance, and a most ingenious invention, used for explo-

ring into workings containing highly poisonous gases. It consists separately of two parts, a mouthpiece and a small casing, or we may term it a knapsack. The principal of the apparatus is that it restores the air to a pure state after it is exhaled, so that it can be inhaled again in a pure condition. When it is required to be used the knapsack is slung over the back of the person who is about to use it, and the mouthpiece is fitted on, which covers the mouth and nose. Two tubes, a supply and a return tube, connect this to the knapsack, in which are constructed two separate compartments, one of them is called the purifying chamber and the other the oxygen storer. These tubes which make the connections are fitted with valves, so that the air can flow in the right direction. The vitiated air, exhaled by the person wearing it, passes through the return tube into the purifier and is there circulated to and fro among sticks of caustic soda, which abstracts the carbonic acid gas from the exhaled air; the air afterwards enters the supply tube, where it is joined by a small stream of fresh air from the oxygen storer, and is then in a fit state to be used again. The oxygen storer is a cylinder about 16″ long by 6″ dia. The purifying chamber which is fixed to it measures 12″ × 12″ × 6″, and is made of vulcanite to withstand the action of the caustic soda and is enclosed in an outer case.

James Leigh, jun.,
278, Whelley, Wigan.
* G. W. Scougall,
Bell's Place,
Bedlington, Northnmberland.

Question 6—How would you ventilate a downbrow place filled with stythe or $C.O.^2$

Answer to Question 6—

The specific gravity of $C.O.^2$ (air being 1) is 1·52, therefore it is one and half times the weight of air, hence it will gravitate to the lowest part of the workings, which will, in this case, be at the working face. I would, first of all, divide the entrance to the level by a canvas partition, one side (the widest) being for the entry and the narrow for its exit. Or it may be done by cutting a channel in the floor and covered over by wooden battens, the intake air passing into the face underneath the floor and the return air passing out above, or air pipes could be used.

Wm. Swan,
5, Brown's Buildings,
Crow Hall Lane,
(Felling), Co. Durham.
* Augus McLellan,
Knightswood, Maryhill.

Question 7—When would you prefer the bord and pillar system of working?

Answer to Question 7—

The method of working coal on the bord and pillar system is favourable (1) When the seams are thick and not intermixed with bands. (2) When the floor of the the seam is of a soft nature. (3) Where large quantities of firedamp $C.H.^4$ is given off. (4) Where the royalty is lying under the sea or under valuable buildings. Thick seams could not be worked on the long wall system if there were no bands to fill up the goaf with, because the roads could not be kept open, as there would be no packing to support the roof. The bord and pillar system is most favourable to seams with a soft bottom, because if the pillars are made in accordance with the thick-

ness of the cover and the angle of inclination of the seam there would not be a downward movement of the overlying strata, which produces what is known as creep; but, as is the case with the long wall method of working, if it was adopted, the roads would rise, because the coal is all taken out, and a downward motion of the roof is inevitable, and great expense would follow in the maintaining of the necessary height of the roads. If the seams give off much gas then the bord and pillar system is applicable again, as the seams could be split up into panels, thus giving each district an independent intake and return, and if an explosion occurred in one district it would not affect the other districts. There are other benefits to be derived from this panel system, but, as brevity is the soul of wit, I will omit them here. It is only reasonable to think that the bord and pillar system can be applied to seams lying under the sea or valuable property, because by leaving the pillars under such places we avoid the movement of the strata above and, finally, preserves them from being interfered with.

G. W. Scougall,
Bell's Place,
Bedlington, Northumberland.

* Jno. Corner,
High Street,
Howden-le-Wear,
Durham.

Question 8—If the hauling engine-house caught on fire down below in the downcast, what would you do if in charge?

Answer to Question 8—

To extinguish the fire in connection with haulage engine-house would be in the same manner as all underground fires is by putting in stoppings both in intake and return near the seat of fire, such stopping to be built with brick walls packed in between with sand to act as a dam, a pipe being inserted to ease off the gases which are given off. Another mode is, by using carbonic acid gas made by means of limestone and hydro-chloric acid and conveyed to to the fire by means of pipes. Another mode is, if none of these modes are successful, to flood the mine, which ought not to be done until all other means fail, as it is attended with great cost, especially if the workings are to the dip.

James Weir,
18, Sunnyside Terrace,
Coatbridge, N.B.

* Jno. Gray,
Glebe Row, Bedlington,
Northumberland.

ANSWERS TO CORRESPONDENTS.

Alex. B. (Terplitz).—The asterisks denote who receives the highly commended. 2—The Mining Exam. is May 9th, 1893. 3—Yes.

J. Weir.—Thanks for letter. 2—Glad you appreciate our efforts.

Relief (Bury).—Cannot say at present. 2—About June. 3—All comes to him with patience.

Nobody (Wigan). — You have certainly chosen a peculiar *Nom-de-plume*. We have answered the query before; *see* back numbers.

Propper.—No idea. 2—Probably "The Yorkshire C. F." Take our advice, *i.e.*, study all.

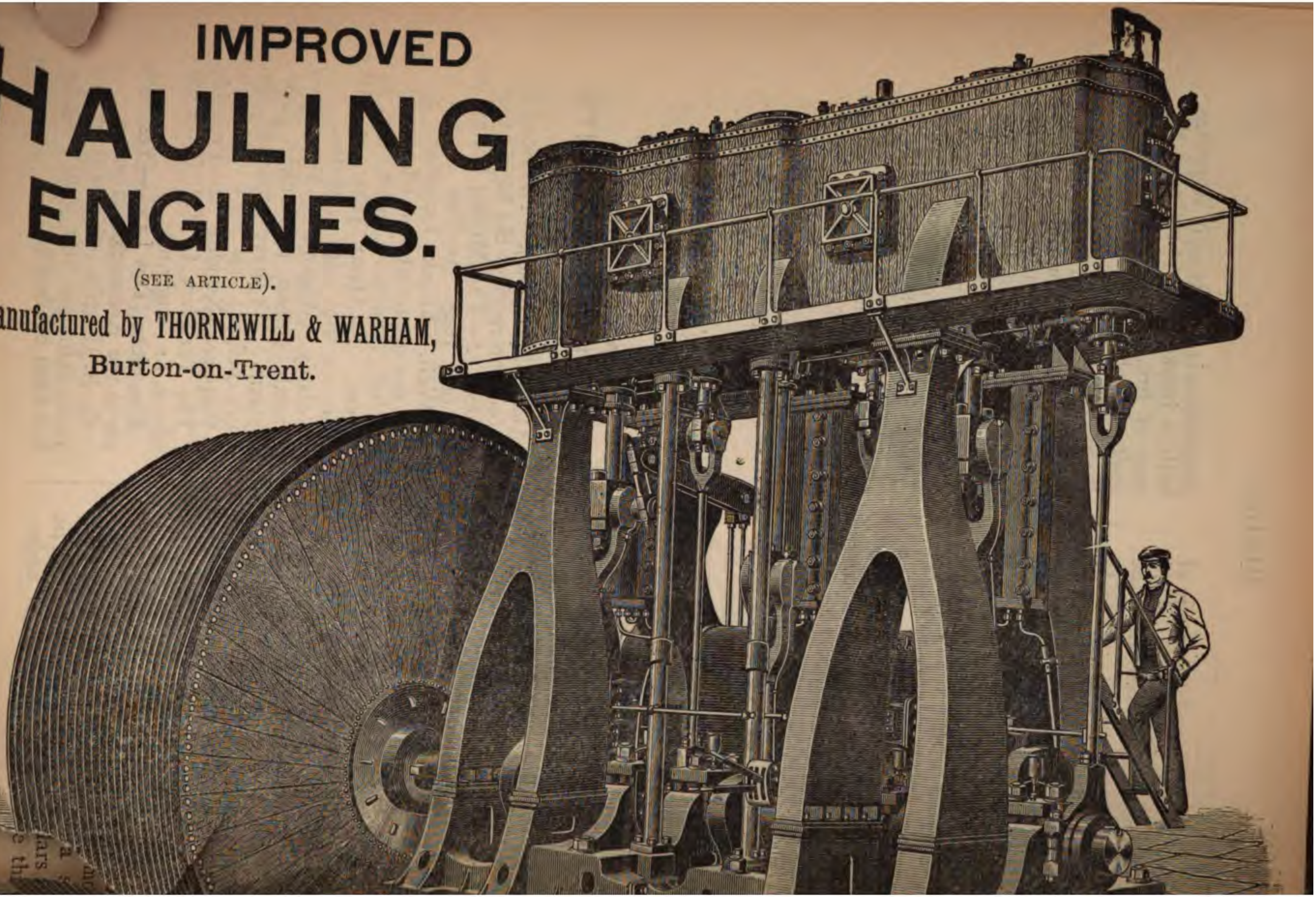
Heamitite (Tow Law).—Yes, both are in the Kensington Museum.

G. R. U. (B).—We will answer yours definitely next issue; it has not been overlooked.

IMPROVED HAULING ENGINES.

(SEE ARTICLE).

Manufactured by THORNEWILL & WARHAM,
Burton-on-Trent.



HAULAGE SYSTEMS.

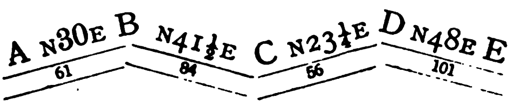
Endless Rope Haulage.

THE endless rope system of haulage is a system where an endless rope passes from the driving pulley along one side of the road, then round a pulley at the far end, and comes back on the other side of the road to the driving pulley. A Walker Differential driving pulley should be used, it has many advantages over others. The empty tubs are attached to one-half of the rope and the full tubs to the other half, the empty tubs go towards the workings and the full tubs to the shaft bottom. As the rope lengthens with use, I should employ a tension carriage, with a pulley placed upon it, the rope being carried half round the pulley, the carriage to be weighted down and travel on an incline, this would take up the slack rope. Any number of branch roads can be worked by this system. The pulley to work branches should have a clutch arrangement to throw it in and out of gear—a very successful one being Fisher's Clutch. The rope may be taken over or under the tubs, both systems have their advantages and disadvantages. Clips are used to attach the rope to the tubs. They should be capable of being easily and readily attached and detached, should not injure the rope, and have few working parts. A good clip, where the rope passes under the tubs, is Fisher's Clip; it acts equally well for uphill or downhill gradients, and can be easily detached. Y-shaped forks are usually adopted where the rope passes over the tubs. The motion of the rope turns the forks and causes them to close on the rope and grip it firmly. The stronger the pull the tighter is the grip, which makes this form of clip suitable for heavy gradients. The hauling engine can be placed on the surface and ropes taken from it down the shaft to transmit power to a series of pulleys situated at the pit bottom. This system of haulage has many advantages over others, as in calculating the power of the engine required to do the work. The inequalities of the road only affect the haulage as far as the mean gradient is concerned; but by the main and tail rope system the greatest rise towards the shaft must be taken into consideration, consequently, a smaller engine is necessary for endless rope than for main and tail rope haulage. The great advantage of the endless rope is the perfect regularity of the delivery of tubs at the shaft bottom. They are, consequently, easily dealt with, and when the full tubs are going down inclines they assist in pulling the empty tubs up. This system can be employed anywhere, although to obtain the best results the roads should be laid out to suit it. The only objection against it is that a double road is necessary to obtain its advantages to perfection. But a double road is expensive to maintain where the roof is bad; but this disadvantage may be, and is, removed by having two separate roads, each laid with a single line of rails, one road for the full tubs and one for the empties. In conclusion this is the system usually preferred on account of the many advantages shown; also, the tubs being attached at regular intervals and its low rate of speed, about three miles an hour, show that the slow moving endless rope is undoubtedly the best system of haulage.

In the foregoing illustration is shown the latest form of Hauling Engines manufactured by **THORNEWILL & WARHAM, Burton-on-Trent,** a description of which we shall give in the continuation of these articles.

SURVEYING.

An ordinary miner's dial consists of two graduated circles at the centre of which a magnetic needle swings freely on a hard-pointed pin, a pair of spirit levels fixed at different angles to level the instrument, a pair of sights fitted with hairs in an exact line with N. and S. of the dial, three strong legs, at the neck of which is fixed a ball and socket joint, to facilitate the levelling of the dial. The north end of the needle is usually distinguished by a mark across it or a small pin through it. The outer circle of the dial is divided into 360 divisions, called degrees (marked thus °), numbered successively from 0 to 360, commencing at N., and going round the circle. The inner circle is divided into four parts of 90° each, viz.:—90 between N. and E., 90 between E. and S., 90 between S. and W., and 90 between W. and N. All modern dials are fitted with appliances for taking dip and for angling, but as these would only confuse the learner, and as they are not necessary for loose needle surveying, I have left them over for another article. There are two methods of surveying underground, namely, loose needle surveying and angling, and as the use of the needle must be learned first, I have chosen it as the subject of this article. Now let us suppose the roadway A, B, C, D, E, from the pit requires surveying. Let A be the pit eye and E the coal face.



Plant the compass firmly on the floor at the point B., adjust it until the bubbles appear in the centre of the levels, and turn the sights in the direction A B. The N. end of the dial should be placed looking away from the pit, so in this instance you will place your eye at one of the narrow slits on the N. sight, and move the dial round until the upright hair in the opposite sight exactly cuts the light which an assistant holds at A. Allow the needle to settle and read off the number of degrees from the inner circle where the marked end of the needle points. Say this reads 30 North East, the distance from A to B should then be measured and noted. Let this measure 61 links.

Next look towards C with the eye at the S. end of the dial, move the dial round slowly until the hair at the N. sight cuts the centre of the light held at C. The bearing and measurement are then taken and booked as before. The dial is then fixed at the point D, and sights taken towards C and E as in the first case. If there should be any roadways driven from A E they should be read off by the chainer. Care should be taken that all iron is removed away from the dial to a distance not less than four yards, as the iron would most probably attract the needle, and the correct bearing of the roadway would not be obtained.

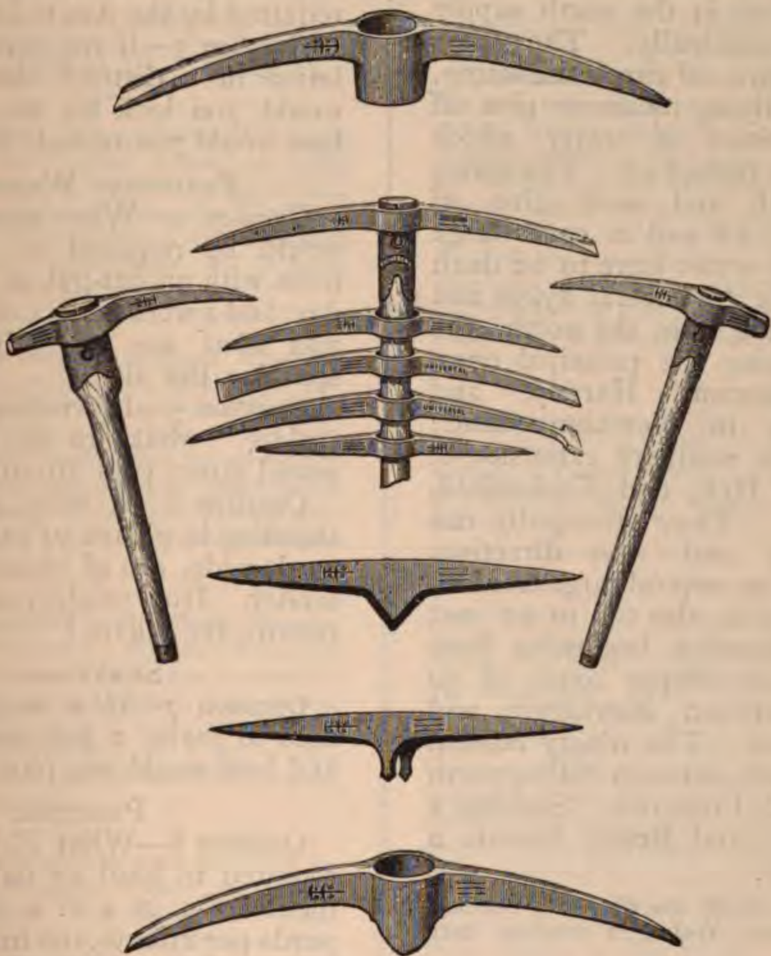
A good method of booking the survey is that shown in sketch, or it may be booked like surface surveys, thus—

	101		End of level.
N	48	E	
	56		
N	23½	E	
	84		
N	41½	E	
	61		
N	30	E	Pit mouth.

(To be continued.)

EXAMINATION QUESTIONS.

In reply to several readers we give below an Illustration of several Picks used in the operations of Mining. The top one is a heavier kind of pick and one used principally for metal work. Immediately below we have the collier's "holing" and "cutting" picks supplied by the **Hardy Patent Pick Co.,** and in this arrangement several picks can be carried on one shaft. To the right and left we have the metal miner's "poll" picks, these having been previously described, and at the bottom we have two other kinds of picks used for tunnelling, etc.



Last year in the advanced stage of the Science and Art Examination for Priciples of Mining, a description of the Lancashire and Cheshire Coalfield was one question, so below will be found a description of the

NORTHUMBERLAND AND DURHAM COALFIELD.

This Coalfield extends from the Coquet in the north to the River Tees in the south, a distance of 50 miles in length, and of an average

breadth of 20 miles. This field is in form like a half-basin; its deepest part is along the sea coast. The general direction of the dip is to the east, although it varies in that respect. The seams in the deepest and eastern part of the field produce an excellent coal for house and gas purposes. The seams in the south and south-west make excellent coke, and the seams in the north supply steam coal principally. The seams in the east give off much fire-damp, and the overlying measures give off large quantities of water which require to be tubbed off. The seams in the north and west give off principally CO^2 and in cases large quantities of water have to be dealt with. There are several dykes met with beginning from the north, the following being the principal ones, viz.:—Bedlington, Hartley, and Coaly Hill, in Northumberland; Hebburn, the southern extension of Coaly Hill, Helt, and Cockerfield, in Durham. They principally run in an east and west direction. There are also several large troubles met with which also run in an east and west direction beginning from north. First dipper south of 50 fathoms, between Newbiggin and north Seaton. The ninety fathom a dipper north, between Killingworth and Gosforth Collieries. Stublick a dipper north, and Butter Knowle a dipper south.

We shall briefly describe every Coalfield in England and Wales, in rotation, until finished.

We will give a uniform reward of 1s. for the best original answers to the following questions. All competitions are subject to the rules given below:—

1st—All envelopes must be marked "*COMPETITION.*"

2nd—To be written on one side of the paper only.

3rd—Correct postal name and address must be sent.

4th—They must reach us by May the 16th, 1893.

VENTILATION.

Question 1—What are the Rules referring to doors?

Question 2—When are safety lamps required by the Act to be used?

Question 3—If you found the ventilation in a district slacken where would you look for the defect and how would you remedy it?

PRACTICAL WORKING.

Question 4—What quantity of air would be required to ventilate a mine with an out-put of 1000 tons a day, and a working face of 1700 yards, and what are the advantages of splitting the air?

Question 5—In visiting a collier's "place" what are the points that would direct your attention?

Question 6—A mine 4 feet thick, standing in pillars 50 yards long, 40 yards wide, dip of seam 1 in 6, roof tender. How would you proceed to remove the pillars?

SURVEYING.

Question 7—How would you proceed to make a fast-needle survey, and how would you plot it?

PUMPING.

Question 8—What H.P. would be required to haul 17 full tubs up an incline of 1 in 4 at a speed of 180 yards per minute, the friction of tubs to be reckoned as $\frac{1}{40}$ of weight?

Question 9—In a shaft of 364 yards deep, there is a feeder of 170 gallons per minute, at 165 yards from the surface, and another feeder of 170 gallons per minute at the bottom. Describe fully, with dimensions, the pumping arrangements you would employ?

Printed and Published for the Proprietor by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

MINING

A Journal devoted to the interests of Mining.

No. 13. Vol. I. May 18, 1893. FORTNIGHTLY ONE PENNY

MINING NEWS IN GENERAL.

Busts of Coal.—A magnificent bust of the president of the United States, is being chiselled out of a solid block of anthracite coal, 5′ square and weighing 5 tons; this huge block was got from the coal mines called Bennet Vein, Plymouth, Pennsylvania, and is being exhibited at the World's Fair.

⁂

Mining Accident.—A telegram from St. Etienne, France, states that a serious fire has occurred at the coal mine, known as Puits-de-Rosiers. The flames which broke out amongst a large quantity of stacked coal, spread rapidly, extending over an area of nearly 1,000 square yards. The firemen were unable to cope with the conflagration. All the mining officials were on the spot.

⁂

The fund originated by the Mining Association of Great Britain for a memorial to the late Maskell Wm. Peace, Wigan, has reached in amounts already received £800, but as several districts have not sent in their returns, the lists cannot be completed for a few weeks. The fund is to be devoted to the foundation of a Mining Scholarship.

⁂

A case of considerable importance is now in progress, viz.:—whether colliers can legally restrict their output. The men at Castle Eden Colliery, on account of some grievance they had only sent out half the quantity of coal per man that had been usual, and were summoned for it by the employers, as they said the colliery could not be worked under such circumstances without some loss. The upstanding charges of £152 per day had to be incurred whether the men worked fully or not. A decision from the authorities is much to be desired, as it is a question which affects many other trades as well as collieries.

⁂

The Silver Medal Competition has again attracted a large number of competitors.

Experiments have been conducted during the past year, at New York, with a new explosive called "Maximite," invented by Mr. Hudson Maxim. This new explosive is a nitro-compound, the base being guncotton, but the ingredients and process of manufacture are a trade secret. It is claimed that 10 oz. of Maximite are equal in effect to 1 lb. of 40 p.c. dynamite, and that it is equal in power to pure nitro-gelatine or nitro-glycerine, bulk for bulk. A speciality of this explosive is that it will not freeze.

⁂

Mines (eight hours) Bill.—When the Committee stage of this Bill is reached, Mr. D. Thomas will move an amendment to the effect that the Bill shall only come into operation in districts in which a majority of the underground workmen so desire.

⁂

On Tuesday, May 9th, was another memorial day for a great many Mining students who are studying under the Kensington Science and Art Department, and I suppose our readers will expect a criticism on the Examination Papers. First—"The Honours stage." This was *not* a fair test in Mining, the first question wanted a tremendous amount of the time to answer it thoroughly, and the others altogether might have been at least nearer connected to the subject they were supposed to represent a test in. In the "Advanced stage," the paper set might be considered a good test either in Metal Mining or Coal Mining, and generally, we think, found favour with students. The "Elementary Stage" was just as absurdly easy as the Honours was difficult; we quite agree that the Honours is set to test advanced reading, but at all events should have kept to Mining proper; altogether I think that there should be a larger per cent. pass this year than ever in the Elementary and Advanced, but it will be decidedly less in the Honours stage.

⁂

In reply to "Imperial" (Leeds), we cannot say just at present. 2.—The Examination in Wigan is in June.

HAULAGE.

WE now take up the continuation of this subject, and it may be to our advantage to find out and simplify some of the difficult problems that must be mastered is this part of mining. The resistances to be overcome :—(1st) Friction varies directly as the weight of the tub and the diameter of the axle, and inversely as the diameter of the wheel. Velocity does not affect it (anyhow, not the velocity used in haulage in coal mining), it depends to a great extent in what manner the haulage roads are kept, with ordinary wheels it may be taken as 24lbs. per ton underground.

TO FIND THE FRICTION OF TUBS.

First find the inclination at which the tub will move without gaining speed or lose it, then—

if F = Friction in lbs.
,, W = Weight of tub in lbs.
,, L = Length of incline in feet.
,, H = Height.

$$\text{then } F \times L = W \times H.$$

The best inclination for horse drawing roads can be found as follows, and is where $F - G = f + G$.

When F = Friction.
,, W = Weight of full load in lbs.
,, f = Friction.
,, w = Weight of empty tub in lbs.
,, G = Weight due to inclination in lbs.
,, H = Height of incline in feet.
,, I = Inclination.
,, L = Distance moved by the tub.

$$\text{then } I = \frac{H}{L}$$

$$\text{then } G = \frac{W\,H}{L}$$

$$\text{So } F - \frac{W\,H}{L} = f + \frac{w\,H}{L} \text{ and } \frac{H}{L} = \frac{F-f}{W-w}$$

$$\therefore I = \frac{F-f}{W-w}$$

To find the size of engine to haul *a given* output a day out from a *given length and incli*nation, and *size of ropes.*

MAIN ROPE :—

Time per trip in minutes = $\frac{\text{Length of road in feet}}{\text{Speed in feet per minute}}$

TOTAL time per trip = time per trip × 3 (allowing $\frac{1}{3}$ to change).

Load per rake in tons = $\frac{\text{Output in tons} \times \text{Total time per trip in minutes}}{\text{Hauling hours per day} \times 60}$

Empties = $\frac{2}{5}$ of full load.

We will now suppose a weight in lbs. per fathom for rope, a weight and distance between each for rollers, to find total weight.

Weight due to inclination in lbs. = $\frac{\text{Load in lbs.} \times H}{L}$

Friction of full load = $\frac{\text{Full load in lbs.}}{70}$ or full load in tons × 32.

Friction rope and rollers = $\frac{\text{Weight in lbs.}}{20}$ or Weight in tons × 112.

The total resistance = weight of load and rope due to inclination + the friction of full load + the friction of rope and rollers.

Load for rope = the total resistance.

Resistance of load per minute = the total resistance × speed per minute.

Work done by engine per minute =

$$M \times A \times P \times S$$

when we call :—

M = Modulas ($\frac{1}{3}$ at least for haulage).
A = Area of Cyls. (= $D^2 \times \cdot 7854$).
P = Effective pressure of steam per square inch.
S = Speed in feet per minute.
D = Diameter of cylinder.

It is usual to take the pressure of steam at about 30lbs. per square inch. We advise our readers to carefully study and work out the above useful information and not merely read it.

(*To be continued.*)

MECHANICS RELATING TO MINING.

Question 1—How many cubic feet of water can be raised an hour from a mine of 200′ deep, by an engine of 50 H.P. ?

Answer—(1st) Find work available in one hour = $(50 \times 33000 \times 60)$ = foot pounds. (2nd) Distance raised in feet = 200 ∴ one cubic foot of water = 62·5lbs. × 200. ∴ Number of cubic feet of water = $\frac{50 \times 33000 \times 60}{62 \cdot 5 \times 200}$ = 7920 cubic feet.

Question 2—A mine is arranged with three shafts which are respectively 50, 60, and 70 fathoms deep. Water is pumped from these levels, viz.: from the first 20 cubic feet, from the second 30 cubic feet, and from the third 50 cubic feet per minute. What H.P. of an engine would be required ?

Work at the first level = $50 \times 6 \times 20 \times 62 \cdot 5$
,, second level = $60 \times 6 \times 30 \times 62 \cdot 5$
,, third level = $70 \times 6 \times 50 \times 62 \cdot 5$

Total work per minute = $(50 \times 20 + 60 \times 30 + 70 \times 50)\ 62 \cdot 5 \times 6 = (1000 + 1800 + 3500)\ 375 = 6300 \times 375.$

$$\therefore \text{H.P.}\ \frac{6300 \times 375}{33000} = 71 \cdot 59 \text{ H.P.}$$

VENTILATION.

VENTILATION is one of the most important subjects connected with mining, and there have been several different schemes adopted to produce ventilation. Three of them are to be considered in this article, namely:—Fans, Furnaces, and the Steam Jet.

Furnace ventilation is produced by placing a large fire at the bottom of the up-cast shaft to rarefy the air, making it lighter, and it ascends the up-cast shaft so rapidly as to cause a partial vacuum to exist, which is filled in with the air from the mine. Furnaces are better for deep shafts because the deeper the shaft the longer the motive column, and the longer the motive column the better for furnace ventilation.

Fans are placed at the top of the up-cast shaft to exhaust the air from the top of the shaft and toss it off the fan blades at such velocity as to cause a partial vacuum in the centre of the fan, or in the fan drift. The pressure of the atmosphere on the top of the downcast shaft presses the air around the workings and up the up-cast to restore the balance. Fans give the best results when applied to shallow mines.

Steam Jets are not very favourable as mine ventilators. It has been thought that they would by the heat and momentum of the steam produce ventilation on a larger scale than either fan or furnace, but the action of the steam after it left the jet quite ruined the success of ventilating mines with a steam jet. Steam condenses and falls, and in this case is like an artificial rain, acting the part of a waterfall and impeding, to a great extent, the progress of the air that has been set in motion by the momentum of the steam, consequently the steam jet is not fit to be compared with either fan or furnace.

The Articles that have been contributed to our "ARTICLE COMPETITION" show a great deal of merit, and we shall be pleased if our readers will write to these Competitions giving their practical experience in any branch they may have more particularly followed, and if they experience any difficulty in anything we shall be pleased any time to help them.

Editor of "Mining."

Why are Lime Cartridges not more generally used?

THE diameter of a Lime Cartridge is 2" to 3" diameter, by 2½" to 3" long. For each charge that is made three or four of these cartridges are placed end to end. There is a perforated copper tube placed in a groove which runs along the cartridge, and after the charge is stemmed, water is forced along the perforated copper tube, which now combines with the lime forming caustic soda, the result of which is that the lime swells to five times its original bulk, and forces off a large piece of rock. They are not in general use on account of the disadvantages attending them. Through the cartridges being so large in diameter, a large amount of time is lost in drilling holes, and the force being gradually developed it does not "punch" or or blast forward beyond the depth of the holing. It will not dislodge a piece of rock out of a solid face, is very feeble compared with other explosives now generally used, when taken bulk for bulk, and when the stemming is the weakest point for the charge to act upon it is forced out, sometimes doing injury to the men's eyes. The heat is intense, and will sometimes ignite the cloth in which the cartridge is wrapped; also, there are so many large and cumbersome articles necessary for each charge, viz., a force pump, perforated tube, bucket of water, &c. When the mine is so dry that the water has to be sent from the surface and the force pump and tube carried from place to place, we can plainly see why the Lime Cartridge is not so favourable as the other varieties.

The juice of bananas makes a capital ink.

NEW GAS-TESTING MACHINE

A new Gas-testing Machine has been invented by a Mr. Shaw recently for testing the pressure of the gases mostly found in mines, viz., Fire-damp ($C.H._4$), Choke-damp ($C.O._2$), and White-damp (C.O.). Formerly the only practicable method for determining the presence of $C.H._4$ was the action of the gas on a safety lamp flame. The only real test for the detection of $C.O._2$ was the action of the gas upon a naked light, while the presence of C.O. could not be detected by any practicable means, and has been the cause of many men losing their lives through encountering a small percentage of this gas. There have been many great improvements in safety lamps, but they have only been fit for use at the working face, and we had not any means of finding out the exact point where an atmosphere charged with gas becomes ignitable. However, this new tester has been brought to perfection, and will determine the proportion of gas necessary to render an atmosphere explosive to the limits of one-tenth to one per cent. When we consider the fact that both choke-damp and fire-damp may be present in the same atmosphere, and that the one has a tendency to lessen the flame and the other to increase it, we realize that conditions of a highly dangerous nature may exist even when the flame of a sensitive safety lamp appears to be normal. In such a case some other test is necessary to ensure absolutely correct ideas of the conditions of the air.

Our space is too limited here to give any details of this useful invention, and we refer our readers to an interesting article given in the *Colliery Engineer* with illustrations and full description.

ARTICLE COMPETITION.

The Prize of 2/6 has been awarded to John Gray, Oliver's Buildings, Glebe Row, Bedlington, Northumberland.

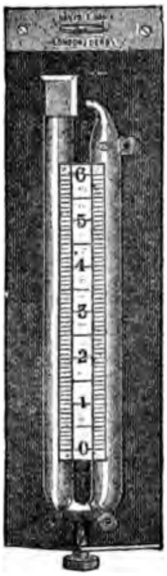
METEOROLOGICAL INSTRUMENTS.

THE Meteorological Instruments that I propose treating on will only be those that are most commonly used in mines, which are the Barometer, Thermometer, Anemometer and Water Gauge.

There are many different kinds of Barometers, too many to be dealt with in this article. The one that is generally used in or about a mine is the tubular form containing a vertical column of mercury. Other fluids can be used instead of mercury, but the length of the tube must be according to the specific gravity of the fluid used. If the fluid was water it would require a tube about 38½ft. long, while with mercury a tube 34in. is a sufficient length, mercury being 13·6 times heavier than water it will balance the atmospheric pressure with 13·6 times less column than water, which makes it the most convenient fluid to use. The barometer is an instrument for indicating the the varying atmospheric pressure, and is read by a scale divided into inches and tenths of an inch. The height of the barometer multiplied by ·4908 equals the pressure in pounds per square inch. It was discovered by an Italian named Torricelli, and is so simple in its construction that any mining student who knows its principle can make one. I will explain how I made mine, for the benefit of your readers. Take a glass tube about 34in. long and ⅛th of an inch bore, then perfectly seal or close one end, provide a trough for it to stand in when completed, make a fulling with a piece of strong writing paper with the edges gummed together, place in the trough what mercury you think it will require, warm the tube so that part of the air will pass out and the remainder will pass off much freer when being filled. Commence to fill the tube, and when full press a finger very tightly on the end of the tube, and while doing so invert the tube and place it very carefully in the trough, and be sure that the end of the tube is below the mercury in the trough before removing the finger, and when fixing the scale measure from the surface of the mercury in the trough and fix the scale accordingly.

There are several kinds of Thermometers but the ones that are most commonly used are the Fahrenheit, Centigrade, and Réaumur. The functions of each are the same, the only difference being in the graduation of the scales. In the Réaumur freezing point is at zero and boiling point at 80°, and in the Centigrade freezing point is at zero and boiling point at 100° degrees, while in Fahrenheit's freezing point is at 32° and boiling point at 212°. They are instruments for measuring heat and the temperature of the atmosphere, and consist of a glass tube with a bulb at one end, the area of the bulb being about 200 times the area of the bore of the tube containing mercury or alcohol. In making Fahrenheit's thermometer the tube must be straight and as uniform in the bore as possible, place the bulb into very finely-powdered melting ice, and where the fluid stands in the tube it is marked and named freezing point. It is then put into steam and the point at which the fluid rises to is also marked, and is called boiling point, the distance between freezing and boiling points being divided into 180 equal parts, zero being 32 of those parts below

freezing point. The tube is then heated to the highest temperature it is intended to measure, and whilst full of mercury the open end is hermetically closed. The height of the barometer must be observed during the process of taking boiling point. The thermometer and barometer are generally used together in mining operations.



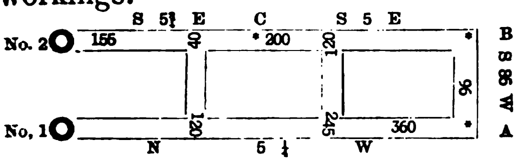
The Water Gauge is an instrument used in mining to ascertain the pressure that is spent in keeping the air in motion. It measures two pressures :—first, that which overcomes the frictional resistance; second, that which keeps the air moving. The water gauge consists of a glass tube bent to the form of the letter U. One of the legs is kept longer than the other, and the extra length bent over at right angles to the legs. This end is connected to the return, and the other leg to the intake, the end of this leg being contracted to keep out particles of dirt, and is also contracted at the bend to prevent the water from oscillating. When the pressure at both ends are equal the water in both limbs are at the same level, but in mines the water is depressed in the intake limb and rises in the return limb. The difference is read by a scale graduated in inches and decimal parts of an inch, adjusted by a screw, the difference in inches and decimals of an inch multiplied by 5·2 equals the pressure in pounds per square foot producing ventilation—5·2 is the weight in pounds of a square foot of water one inch deep. I have *sometimes been asked* if this is true: How can one inch of water in a tube with an area of ·25in. give the pressure of a square foot of water one inch deep? To those who are not advanced in mining I may say the area of the tube makes no difference; the pressure is proportionate to the area. The total pressure on the water in the tube is not 5·2lbs., but only in that ratio; and as 144 is to 5·2, so will ·25 be to the actual pressure on the water in the tube, which will be $\frac{\cdot25 + 5\cdot2}{144} = \cdot009$ pounds pressure on the water in the tube. The water gauge is used in so many different formulas in ventilation that I cannot deal with them here.

There are many different kinds of Anemometers, but the principle and use of all are the same, which is to measure the velocity of the air, in mining. It consists of a hoop within which revolves a wheel carrying vanes; the vanes are so arranged that when the instrument is held at right angles to the direction of the air the vanes will be obliquely to its path; the force of the air on the vanes causes the wheel to revolve which works toothed wheels of various diameters, and to their spindles are attached pointers which indicate by the dial or dials the velocity of the air in feet, in units, tens, hundreds, thousands, and in some cases more, for the time held in the airway. It is provided with a stop so that the instrument can be stopped at a set time when measuring. When measuring with the anemometer a small amount should be allowed for friction, and this amount is stated by the maker after having tested the instrument before being sold. There are many different ways in measuring the velocity of the air. Before commencing, the reading must be noted, and each preceding reading deducted from the reading

after measuring. The most correct way is to take a measurement on each side, top, and bottom for one minute in each case, and divide by 4 to get the mean velocity; take another measurement in the centre for one minute, and add this to the mean and divide by 2, which will equal the velocity in feet per minute, and the velocity multiplied by the area equals the quantity passing.

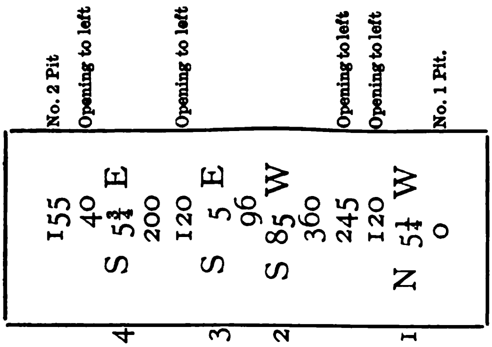
SURVEYING.

IN the article on the above subject in last issue we gave a description of the essential parts of a dial necessary for loose needle surveying, and the manner in which a single place is surveyed. We will now give a description of the method pursued in surveying the two levels driven from the pit shafts. Let the following figure represent such workings.



Now as the main levels would be driven by lines it should be possible to take a sight from one end to the other, so the dial must be placed in position at point A. Then with the eye at the N end of the dial, place it in such a manner that the S sight cuts the light held at the centre of pit No. 1. Allow the needle to come to rest, and immediately it has done so, read off the bearing pointed out by its marked or N end. We will say this is N 5¼ W. Next turn the dial round until it points in the direction of B, and with the eye at the S sight, fix the dial and note the bearing as before. This gives S 85 W. Measurements must then be taken, commencing from No. 1 pit, and measuring towards A, and reading off the opening as we go along. Thus the first opening measures 120, the second 245, and the full length of the bearing is 360. Next measure the distance between the points A and B, this is 96. These should then be entered in the book. The dial is then taken up and fixed at C, looking through the N sight until the S sight cuts the light held at B, the bearing is read and found to be S 5 E. This bearing having been duly recorded in the book, the bearing between C and No. 2 pit is taken (the eye in this case being placed at the S sight) and reads S 5¾ E. The distance from B to C is then measured, the intermediate length being also read off. The latter reads 120, and the length of the sight is 200. The distance between C and No. 2 pit is next measured, with its intermediate length. These are 40 and 155. If the bearings and the measurements have been taken correctly, the survey should tie itself in when plotted on the plan.

Now a word as to the method of booking. If a sketch is made, and I consider this the best plan, the bearings must be booked outside the road sketched, the intermediate lengths must be booked across the direction of the road, and the lengths of the bearings in the same direction as the road. A glance at the figure given will enable the reader to understand this. The reason for booking in this manner is to escape the trouble which would otherwise occur whilst plotting the survey if there was no distinguishing mark between the intermediate and full lengths. Below is another method of booking the same survey. You commence at the bottom, and book upwards :—



WHAT IS THE BEST EXPLOSIVE?

THIS is not only important but a very difficult question to answer. During the last 20 years a multitude of patent explosives have been brought before the mining authorities, all of which claim certain qualifications. In my opinion the palm must be awarded to one of the following three—Gunpowder, Dynamite, or Roburite. The first is a slow or rendering explosive, the 2nd shattering compounds for stone blasting in mines, and the 3rd a flameless compound for coal mines. For a rending explosive for blasting coal, practical experience proves that no substance has yet been invented to surpass Gunpowder. The action of powder being slow, the coals are torn from the face, bringing down a better sample of coal, and on the whole giving better results to the miner. The following quotation from a paper in the transactions of the mining society in Nova Scotia, by H. S. Poole.—"A Cape Breton miner, who knows that in his country some 19,000,000 tons of coal have been won by the probable consumption of 1,500 tons of powder, without the occurrence of an accident involving the lives of as many as three *men, can*not see wherein the danger lies that is in excess of other sources of accident to which he knows he is exposed,"—will probably come as a surprise to many, because the use of Gunpowder, pure and simple, in a fiery or dusty mine is attended with some considerable danger. Of course the danger is lessened by the use of the water cartridge. The advantages of Dynamite when compared with powder are, bulk for bulk, it is seven times stronger, its explosive force is not impaired by being placed under water, holes of less diameter are required, and as a consequence less labour, but as an all-round explosive it is inferior to Gunpowder for general pit work. There are several binary compounds in the market to-day, which are called flameless. Among these the only serious rival to powder is Roburite. From the experience of practical men and experts I believe Roburite to be the best explosive of the present day. Of course there are disadvantages attending its use. Its advantages are, (1) It is a safe explosive in a fiery or dusty mine, which is to-day the most important feature of any explosive. (2) Owing to its superior strength it is suitable either for hard or medium rock. (3) Less labour is required in drilling holes.

THE YORKSHIRE AND DERBYSHIRE COALFIELD.

GEOGRAPHICAL BOUNDARY.

This Coalfield extends as far north as Leeds, and as far south as Derby and Nottingham. The western boundary line is a little west of Bradford by Huddersfield, Penistone and Belper. The extent of the coalfield on the eastern side is very indefinately known, the coal measures being overlaid by new geological

formations which have been pierced by several shafts.

Geological Dimensions.

The total length of this coalfield north and south is 60 miles, while its breadth east and west is set down at from 5 to 20 miles. The area of coal exposed is 760 square miles, while the unexposed area on the eastern side under the Triassic and Permian rocks is set down at 900 square miles. The Yorkshire coal measures attain a thickness of 3,000′, the lower several hundred feet being noted for containing flagstone and seams with a ganister floor. There are altogether 15 or 16 seams with a total thickness of 45′

Principal Seams.

Top hard coal in Derbyshire known in Yorkshire as the Barnsley seam which is partly anthracite, its thickness in Derbyshire is about 5,, but in Barnsley it is upwards of 9′; also the lower hard coal, upper and lower soft coals. The soft coals are known in Barnsley as the silk-stone, they are of a bituminous nature and makes good house coal.

Direction of Bleat.

The direction of the bleat is nearly north and south, and in the Morley and Beeston Hill district it is S 20° W.

Water and Gas.

The quantity of water and gas depends to a large extent upon the depths of the seam; seams worked near the outcrop sometimes contain a large quantity of water, but are moderately free from inflammable gas, while on the other hand seams which are over 600′ deep are of a fiery nature, but moderately clear of water. Of course there are exceptions.

Systems of Working.

There are the longwall, pillar and stall, and Barnsley systems of working coal in force in this coalfield; there are also modifications of the longwall method, and one of which would be better described by being called the circular method. The centre of the face is worked in advance of the two extremities, in fact the nature of the roof and floor of the seams compel managers to modify any of the above systems or incorporate them all in the same mine.

Haulage.

Self-acting inclines, endless rope, main and tail rope, all of which three systems are occasionally to be met with in one pit.

Generalities.

In Yorkshire alone there are 2,500,000 tons of coal per year raised, which is used for exportation, steam raising, coking and domestic purposes, giving employment to about 200,000 men in and about the collieries.

GEOLOGY.

To study geology proper, the geological time, as it is called, has been divided and sub-divided as follows:—

Archaen. — This comprises the earliest known rocks, which show no trace of either animal or vegetable life whatever.

Paleozoic (Ancient Life).—This series includes the time when the very earliest life made its appearance and existed.

Mesozoic (Middle Life). — This series contains the more advanced form of life, which flourished directly after the Paleozoic period.

CAINOZOIC (Recent Life).—In this age there flourished a great many forms of higher life, previous to the time when man made his appearance upon the earth.

QUATERNARY.—In this series man came upon the globe and with him the very highest forms of life in the animal and vegetable kingdoms.

These five divisions are again subdivided as follows, and is known as the Geological Record :—

ARCHAEN.—Pre Cambrian.

PALEOZOIC.—Cambrian : Upper—Tremadoc Slates, Lingula Flags. Lower—Menevian Group, Harlech Group.

SILURIAN.-Upper: Ludlow Group, Wenlock Group, and the Upper Llandovery Group. Lower includes the Lower Llandovery Group, Caradoc Group, Bala Group, Llandeilo Group, Arenig Group.

DEVONIAN AND OLD RED SANDSTONE includes 1st Devonian. Upper—Goniatite Beds. Middle—Limestones. Lower—Sandstones.

OLD RED SANDSTONE.—Yellow and Red Sandstones. Lower Sandstones, Flagstones and Conglomerates.

CARBONIFEROUS includes the Coal Measures, Millstone Grit, Carboniferous Limestones.

PERMIAN includes :—Upper Red Sandstone, Clays, Gypsum, Magnesium Limestones, Marl Slate, Lower Red Sandstones.

The above is the whole of the sub-divisions of the Archaen and Paleozoic formations, and it will be easily seen how important to the Mining student is a knowledge of the above, for in the Paleozoic is contained the Carboniferous series.

We shall, in a future article, sub-divide the other formations, and then briefly describe each.

(*To be continued.*)

ANSWERS TO QUESTIONS.

Question 3—What are the Rules referring to self-acting planes ?

Answer to Question 3—

General Rule 14 says that every underground plane on which persons travel, which is self-acting or worked by an engine, windlass, or gin, shall be provided (if exceeeing 30 yards in length) with some proper means of communicating distinct and definite signals between the stopping places and the end of the plane, and shall be provided in every case with sufficient man-holes for places of refuge at intervals of not more than 20 yards, or if there is not room for a person to stand between the side of a tub and the side of the plane then (unless the tubs are moved by an endless chain or rope) at intervals of not more than ten yards.

W. SUTHERLAND,
Granville Terrace,
Stoney Lane,
Hindley.

Question 5—Sketch, describe, and give relative cost of an air crossing for 50,000 cubic feet per minute.

Answer to Question 5—

Sometimes one crossing does for two splits, and taking the velocity at 10′ per second the crossing should be shot out 12′ wide and to be 7′ high above the bridge when finished. The bridge is commenced about 3′ back from the road, to be crossed and finished the same distance on the other side; all loose coal and stone must be removed and the stone

shot out. The crossing is laid against the bridge which makes it stronger and air-tight and a more complete bridge; this being a large air crossing and the stone somewhat favourable it would cost about £20, but the cost depends on the class of air crossing wanted, cost of bricks, lime, labour, height of airway, size of air crossing, nature and hardness of the stone. If the crossing has to be made in the solid rock it would cost four times as much as one made with bricks; if the stone is ordinary blue metal an air crossing can be shot out for about £10, but if there should be part port stone about £15, and if it should be all port £20; then the cost of bricks, lime and building, which will be about another £5. If the stone is very soft, this will necessitate another arching above the crossing, but as the stone will be cheaper got out it will cost about the same owing to the extra building.

JOHN GRAY,
Glebe Row, Bedlington,
Northumberland.

Question 6—To raise 800 tons per day, give size of cylinders, stroke, diameter of drum, number of revolutions, number and class of boilers. Depth of pit, 370 yards.

Answer to Question 6—

To work out this question the H.P. of the engine must be got; supposing then eight hours is the time spent in winding coal, the H.P. will be thus—$\frac{2240 \times 8{\cdot}00 \times 370 \times 3}{33000 \times {\cdot}7 \times 8 \times 60} = 17{\cdot}850$ H.P., nearly, ·7 used as the modulus of the engine. Supposing then the pressure of steam to be 40lbs. per square inch, the length of stroke 5′, and the number of revolutions 40 per minute, the size of cylinders will be $\frac{178{\cdot}50 \times 33000}{40 \times 5 \times 2 \times 40 \times {\cdot}7854} = \sqrt{468{\cdot}75} = 21{\cdot}65''$ diameter. Assuming that 2 tons of coal is raised in one run, then to find the diameter of drum I do it thus $\frac{178{\cdot}50 \times 33000}{2240 \times 2} = 1314{\cdot}84'$ speed of the cage in the shaft per minute, then $\frac{1314{\cdot}84}{40} = 32{\cdot}871'$ circumference of the drum, and $\frac{32{\cdot}871}{3{\cdot}1416} = 10{\cdot}46' =$ diameter of the drum. I would have the Lancashire boilers with double flues, the boilers to be 7′ diameter, and each flue 2·25′ diameter and 25′ long; then $7 + 2{\cdot}25 + 2{\cdot}25 = 11{\cdot}5'$ sum of the diameters of the boiler and flues, and $\frac{11{\cdot}5 \times 25}{8} =$ 36 nearly H.P. of one boiler, therefore the number of boilers required will be $\frac{178{\cdot}50}{36} = 4{\cdot}68$, practically five boilers will be needed.

H.P. of engine, 178·50
Diameter of cylinder, 21·65″
Length of stroke, 5′
Number of revolutions, 40
Steam pressure, 40lbs. per sq. inch
Diameter of drum, 10·46′
Number of boilers five, each 7′ diameter, with two flues 2·25′ diameter each.

JOHN GRAY,
Glebe Row, Bedlington,
Northumberland.

Question 7—What cost and size, etc., of hauling engines would you put down to haul 20 tubs of coal of 7cwt. up at brow dipping 1 in 7.

Answer to Question 7—

This being a practical question, the necessary allowances for the friction of the rollers, sheaves, tubs and engine, will have to be made. Suppose the speed to be 200 yards per minute, tubs to weigh half the weight of coal, the tractive force to be 30lbs. per ton, and allowing a

modulus of ·4 to meet the friction of the rollers, sheaves and engine, the H.P. of the engine should be $\frac{20 \times 7}{20} + \left(\frac{3\frac{1}{2} \times 20}{20}\right) = 10\frac{1}{2}$ tons weight of coal and tubs, then $10{\cdot}5 \times 30 \times 200 \times 3 = 189000$ units of work due to tractive force, and $\frac{10{\cdot}5 \times 2240 \times 1 \times 200 \times 3}{7} = 2016000$ units of work to overcome gravity. $\therefore \frac{2016000 + 189000}{33000 \times \cdot 4} = 167$ H.P. required. Cost of engines and boilers about £1,700.

JOHN GRAY,
Glebe Row, Bedlington,
Northumberland.

We will give a uniform reward of 1s. for the best original answers to the following questions. All competitions are subject to the rules given below:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on one side of the paper only.

3rd—Correct postal name and address must be sent.

4th—They must reach us by May the 27th, 1893.

ELEMENTARY.

Question 1—What kinds of metallic ores and other useful minerals are usually found in stream-works or alluvial deposits?

Question 2—When a coal seam is cut off by a fault, what operations are necessary to prove the throw?

Question 3—Describe the principle of the safety lamp and the construction of one of the safest forms.

ADVANCED.

Question 4—Give a sketch of the method of sinking and walling in ordinary coal shale and sandstone measures when intermediate bearing curbs can be used. What weight of material would be excavated per 100 yards in a pit 16′ in diameter?

Question 5—Describe a system of working a 4′ seam of coal of 35 to 50 degress dip, either by dip or rise working, showing the methods of securing the faces and of removing the coal to the main road, and the course of ventilation.

Question 6—Describe with figures the construction of a cage and guides suited for a large colliery.

HONOURS.

Question 7—Give an account of the Scotch coalfields, and compare their geological characters with those of the northern counties of England.

Question 8—What are the principal deposits and the nature of their minerals producing iron ores of Bessemer quality in Europe at the present time?

Question 9—Describe Mr. Moore's system of hydraulic transmission of power from surface to pumps underground.

SILVER MEDAL COMPETITION.

The Winner will be announced in our next.

We are preparing a series of Practical Articles on Ventilation which should prove of the greatest importance to everyone connected with the Science of Mining.

Editor of Mining.

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// MINING

A Journal devoted to the interests of Mining.

No. 14. Vol. I. JUNE 1, 1893. FORTNIGHTLY ONE PENNY.

MINING NEWS IN GENERAL.

The first number of the new Board of Trade organ, the *Labour Gazette*, has just been published. Chambers of Commerce, Employers' Associations, and many others, have been asked to assist the investigations of this department. Arrangements have also been made with several Government departments for the supply of information. Representatives of the department have gathered information on the spot with regard to the cotton dispute in Lancashire and the dock dispute at Hull, and it is stated in the memorandum that it is intended to act in a similiar manner in important disputes in future.

***

In 1857 there were in the Dortmund mining district a total of 299 collieries, at which were employed 30,600 men, who turned out 4,004,000 tons of coal. The number of men per colliery averaged 103, and the coal output at 131 tons per man. In 1890 there were 175 collieries, with 117,800 men, who were able to produce 35,409,200 tons. At that time there averaged 750 men per colliery, who had an average output of 277 tons per man.

***

From the opinion of a London firm, who have written to the *Times*, the success of the recent record passage of the new Cunarder, "Campania," from New York to Queenstown, has been accomplished by the use of the Pocahontas semi-cituminous coal of Virginia, with which the White Star and Cunard Lines have been supplied for some time past at New York. This Pocahontas coal, which contains by analysis about 86½ per cent. pure carbon, runs the best Cardiff descriptions very close. The supply is, moreover, inexhaustable, the seams frequently being 10ft. to 12ft. thick, and extending over an area of some 300 sq. miles. The coal is brought to Norfolk, Virginia, a distance of nearly 400 miles, over the Norfolk and Western Railroad, and is then shipped to New York. The yield from this property during last year reached the enormous total of nearly 3,000,000 tons.

The winning of a fine seam of coal at the Tirpentwys Colliery, in the neighbourhood of Cwmffrwdoer, Pontypool, has caused much gratification in that district. The new seam is known as the "Big Vein," and has been found in true position in the ground, at a depth of 395 yards from the surface. Another seam, known as the "Elled," was struck a few weeks ago, and it is understood to be the intention of the Company to open out on these two seams at once.

***

From a report recently issued, it appears that during the past year the number of mines at work, of all kinds, was 4,257, for the whole of the United Kingdom; the total number of persons employed was 721,808, and the amount of mineral raised was 195,880,580 tons, of every description. The total number of fatal accidents was 862, and the number of deaths resulting therefrom was 1,034, being a decrease of 99 in the number of fatal accidents, but an increase of 4 in the number of lives lost, as compared with the preceding year. There was one death for every 679 persons employed, as compared with one in 668 for the year 1891. The deaths in coal mines were 982, being a decrease of 97 over the preceding year.

***

The recklessness of miners has once more been shown in using naked lights and risking their lives. An explosion occurred last week at the Old Park Colliery, belonging to the Earl of Dudley. An overlooker, employed in the mine on the fatal morning, stated that the lamps were there and in good order, but he did not put them in the men's hands, nor did he consider it his duty to lock them. On this statement, Mr. Scott, Government Inspector, said that if the overlooker had put lighted and locked lamps in the hands of the men instead of candles they would have been alive now. It was admitted also, by the doggey, that on the following day they worked with candles, thus showing that experience fails to make the men wise.

ARTICLE COMPETITION.

The Prize of 2/6 has been awarded to John Gray, Oliver's Buildings, Glebe Row, Bedlington, Northumberland.

HAULAGE.

IN the Mine of which I am personally acquainted there are two kinds of rails, 4 feet wrought-iron plates which are used on the barrow way, that is the road from the flat to the working face, the point turns being cast-iron.

Those used on the rolley way are round topped wrought-iron fish rails, usually about 12 feet long. They are made fast to wood sleepers by nails or dogs, and the ends secured to each other by fish plates, one on each side. overlapping the ends of the rails, and made fast by bolts passing through the fishes and rail. The width of the road is 2 feet 6 inches, the tubs are iron and stand 2 feet 6 inches above the rails, they are wider at the top than the bottom which gives them the appearance of a coal wagon, and they usually carry about 8½ cwt. of coal. The output of coal is about 1,000 tons per day at 10 hours a day.

There are three Hauling Engines, two of which work each an endless rope and the other a main haulage rope. One of the endless rope planes runs in a north-westerly direction, with branch roads to the west and north-east for an extent of 1½ miles from the shaft.

The tubs are put on to the rope singly, about 30 yards apart, and the speed varies from 3 to 5 miles an hour, and hauls about 750 tons per day. For a considerable distance along the plane there is a travelling road 4 feet wide, which is always kept in splendid condition, with man *holes as required* by the Act.

The other endless rope plane goes east from the shaft for a distance of 70 yards, dipping 6 inches to the yard, at the bottom of the incline there is a heavy curve with the same gradient to the south, from this point the plane is level for a distance of 200 yards, where there is a branch to the east for half-a-mile. I have heard it said that the endless rope cannot be worked round a curve, but I may say that in this case it is, and a very heavy curve, rising 6 inches in the yard to the shaft. The full tubs pass on the inside of the curve, and around the curve there is guide rails for the tub to slide against. The jockey carrying the rope is in the centre of the tub at the fore-end, and to keep the rope in the centre of the tub horizontal sheaves are arranged about 6 inches apart round the curve. The sheaves project half way across the tub so that the jockey strikes the sheaves as the tub passes round. The empties on approaching the curve are made to leave the rope and pass round the curve of their own accord, and are put on to the rope again by a strong lad. The speed is about 5 miles per hour, and the daily output about 160 tons.

The main rope plane runs west, the plane is level for about 70 yards from the shaft and then dips 6 inches to the yard for 250 yards; this is a drift driven to another seam which has just started: the output is about 90 tons a day. Each plane has it own code of signals which are given by electric bells worked by powerful batteries; the batteries, bells, and planes are examined every 24 hours.

Seven years ago a self-acting incline, straight west from the shaft for about a mile in extent, was worked by an endless rope. The rope passed round a sheaf at the top and

bottom of the incline. The top sheaf was provided with a friction brake to stop the run when required. The road consisted of three lines of rails, and at regular distances they increased to four lines, forming two roads or sidings for the full and empties to pass. The tubs were run in sets and had to be put on to the rope at a definite point so as to pass clear in the sidings. The rope ran below the tubs, the first and last tub being attached to the rope, and rollers were placed 15 yards apart to carry the rope.

I should have said at the commencement that the Hauling was done by ponies from the face to the flat, and from the flat to the plane by horses.

John Gray,
Glebe Row,
Bedlington, Northumberland.

GEOLOGY.

Following up closely these geological sub-divisions, we notice the Mesozoic, which is again sub-divided in Triassic, Jurassic, Cretaceous, and these again as follows :—

Triassic.—Rhaetic, Keuper or Upper Trias, Muschelchalk, Bunter or Lower Trias.

Jurassic is sub-divided in more divisions than the Triassic, and are known as—Purbeckian, Portlandian, Kimmeridigian, Corallian, Oxfordian, Bathonian, Bajocian, Liassic, coming then to the last, the Cretaceous as it is known, as we find it sub-divided into—Danian, Senonion, Turonion, Cenomanion, Gault, Neocomian.

The next we shall find in reference to our last number is the Cainozoic, sub-divided into Pliocene, Miocene, Oligocene, Eocene, and Thinohe.

Post Tertary, which includes the times known as Recent and the Pre-Historic, also the Pleistreme and Glacial.

Now that we have taken the various sections that geological time has been separated into, we will commence with a description of that known as the Archaen Period, briefly noticing everything of importance in this the earliest periods of our earth and consequently the oldest. The rocks of this period have been thought by some Geologists to belong to and actually be the crust of the original planet. Several theories have been formed, and as these articles have been specially to study the more elementary principles of geology, we shall not therefore go into the details of the various unsettled problems. All Archaen rocks are known by their crystalline appearance and as an example, suppose we take Gneiss, which is by far the most abundant; then we have Granite, Serpentine, Graphite, Hæmatite, Magnetite, Limestone, and many others.

(To be continued.)

COMPARATIVE COST OF HAULAGE BY PONIES OR POWER.

In drawing up a report on the above subject a great deal must be assumed. We shall assume that in an imaginary pit there are fifty ponies—without taking their original cost into consideration; also that an engine and boilers are among the plant without considering their original cost. The following table formed from practical results, will show the approximate cost of keeping fifty ponies—provender mixed in the following proportions :—

Corn	47·38 %	
Bran	10·46 %	
Chopped Hay	42·16 %	
	100·00 %	

	£	s.	d.
To 240 stones of Corn, at 11d. per stone	11	0	0
„ 53 „ Bran, at 9d. „	1	19	9
„ 142 „ Chopped Hay, at 4½d. „	2	13	3
Total	15	13	0
To this must be added 50 drivers wages, say at 2s. 6d. per day	37	10	0
Also Four Horsekeepers wages, at say 30s. per week	6	0	0
Total	£58	3	0

Therefore the cost per week for fifty horses, fifty drivers, and four horsekeepers, will be about £58.

In a good boiler 1lb. of coal will evaporate 8lbs. of water, and every pound of water evaporated per hour is equal to one H.P., allowing $\frac{3}{10}$ of the modulus of the engine for condensation of steam passing from boiler to engine, friction of engine, &c. We shall need a boiler capable of supplying a $\frac{50 \times 3}{10} + 50 = 65$ indicated H.P. of engine. Assuming that 30lbs. of steam is equal to a unit H.P. the number of pounds of coals necessary to evaporate steam for the above engine is equal to $\frac{65 \times 30}{8} = 244$lbs. per hour nearly. Suppose the pit to work ten hours per day, six days per week, the quantity of coals required will be equal to $\frac{244 \times 10 \times 6}{2240} = 6{\cdot}53$ tons; to keep the fire burning over-night and on Sunday, say 3·47 tons; making a total of 10 tons per week.

	£	s.	d.
Cost per ton, say 8s.	4	0	0
Boiler and Engine Tenter's Wages	2	10	0
Ten men and boys on the Engine Plane—men at £1 and boys at 5s. per week	12	10	0
Total	£19	0	0
	58	0	0
	19	0	0
Difference in favour of Engine	£39	0	0

It may be urged that provender will not cost as much as stated, if so, coal will not cost 8s. per ton. No allowance is here made for breakage of harness, bedding for ponies or accidents to ponies, neither is anything allowed for accidents, oil, &c., for engine and boiler.

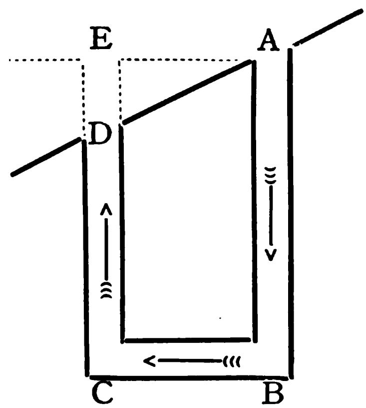
WINDING ROPES.

THE ropes used for winding purposes are made from hemp, iron, or steel. Hemp is now seldom used except for small shafts or winzes, on account of the huge size of rope that would be necessary to withstand the strain of the loads of minerals usually wound; and again its weight compared with steel wire rope working under the same conditions would be three times as heavy, and would not wear for near so long a time, so we can disregard the hemp rope at least for winding purposes. This leaves us for consideration—iron and steel wire ropes. Steel wire has the advantages over iron wire of only weighing two-thirds its weight and not being so large for the same working load. As to the length of time each will wear, the steel wire lasts rather the longer of the two, its first cost is more, but taken all round there is very little difference in the total cost for each year of wear. We now come to the different kinds of shapes in use, namely—round and flat; the flat rope was used extensively several years ago and is still in use at many collieries, but it is only at such places where the vertical drums cannot very well be changed. The advantages claimed for flat ropes are, there is no tendencey for the rope to slip, the rope does not twist, and it acts as a counterbalance to

the engine; these are in part true, but we may have a counterbalance with the round rope by using a specially constructed drum, as for the twisting of the rope this matters little except at sinking pits, because the cages are provided with conductors. But if there is any advantage in its not twisting it is not an advantage over round ropes, for round non-twisting ropes are now constructed for sinking purposes. The flat rope is almost twice the weight of the round rope for the same load, and as the price varies with the weight it costs almost twice as much. The round rope will wear for a far longer time, so we see that the round rope is undoubtedly the better.

VENTILATION.

IF the ventilation of a mine be naturally produced from two shafts, the deeper shaft will be the downcast and the shallow one the upcast in warm weather, and the shallow shaft will become the downcast in cold weather. We will now try to understand the reason for this change in direction and the cause of the production of the current. The temperature of the strata in the mine is almost constant, the temperature above not affecting it, except in very shallow mines; and it is greater than that of the atmosphere in winter and less in summer. As air expands when heated, and becomes lighter, bulk for bulk, the weight of the air in shaft A B (see fig.) will be greater in summer than the weight of the column C D E (D E being the atmosphere to a height equal to the height of shaft A B); and as the pressure of the air above these points are equal, there will be a current of air produced in direction shown by the arrows. Now, in winter, the temperature of the mine will be greater than that of the atmosphere, consequently, the weight of the air in contact with the strata will be greater than that of the atmosphere. Therefore, the column of air A B will be heavier than column C D E, and the current will flow down D C and up A B. To prove this mathematically let us take the following proportions:



If the shaft A B be 200 yards deep, and the shaft D C 150 yards, and the weight of the atmosphere be taken as 5 per yard in winter, and the weight of the air in the mine as 4 per vertical yard then—

Weight in shaft A B = 200 yards × 4	=	800
Weight in shaft D C = 150 yards × 4	=	600
Plus do. of column of atmosphere DE=50 × 5	=	250
		850

Therefore weight of column AB=800, and weight of column C D E = 850. So we see that there is a force of 50 pressing down D E, and this forces the air up A B, thus causing that shaft to become the upcast. Again, take the weight of the atmosphere to be 4 on a warm day, and that of the air in the mine 5, then the respective weights are—

Shaft A B = 200 yards × 5..................	=	1,000
Shaft C D = 150 yards × 5..................	=	750
Column of atmosphere = 50 × 4............	=	200
		950

From this we see that there is a balance in favour of the shaft A B of 50, therefore A B is the downcast and C D the upcast. The greater the difference between the depths of the two shafts and the greater the difference between the temperatures of the mine and atmosphere, so the greater the quantity of air circulated by natural means. From the above reasoning it will be seen that there will be a time when the column of air in each shaft exactly balance each other, and the ultimate result of such equilibrium would be to stop the ventilating current. The remedy adopted for such an occurrence is to place a fire at the bottom of one of the shafts, thus creating an upcast. And this fire must be kept burning until such time as the temperatures are of sufficient difference to again circulate the air naturally. Although natural ventilation is very economical, and has, undoubtedly, given very good results in many cases, yet on account of its unreliability to produce a definite current it cannot be depended upon; and it is now almost universal to have some artificial means of furnishing the necessary ventilation.

EARLY HISTORY of MINING.

ALTHOUGH we have no positive proof of coal mines being worked before A.D. and everything stated of it is a matter of conjecture, yet there is uncontestable evidence such as the finding of ancient tools, coins, etc., which confirms us in our belief that coal was worked by the early Britons. Axes, picks, spades and wedges, have been found in old coal mines made of wood or flint, *and as* it is quite improbable that *such rude implements* would have *been used if iron* had been previously known; these take us back to a very early period of history. With such like discoveries as these upon which to base our opinion, it has been generally accepted that there is every reason to believe that the early Britons and with more certainty the Romans were aware of the properties and value of coal as fuel. It is quite easy for us to understand why they did not work the mines except by way of experiment, when we consider that the greater part of Britain was covered with vast forests from whence wood could be obtained without the danger and difficulty which attended the winning of coal. There is documentary proof of the use of coal about the middle of the ninth century, and in 1306, the English Parliament issued a proclamation prohibiting the use of coal, as it was said that the products of combustion issuing from it polluted the atmosphere and rendered it unhealthy. But this proclamation was short lived, for the inhabitants of Britain in general began to recognise more fully the advantages of using coal; and again the alarming decrease of the forests from the great strain on their resources and the ever increasing amount of fuel used was a matter of great anxiety, so a very few years after the issuing of the proclamation saw coal mines being worked to a far greater extent than before, in fact we might consider this period as the first in which any real attempt was made to mine coal. The appliances used at this early stage appear to us to be of the most elementary and rude description, as indeed they are compared with the elaborate arrangements now in use; but for their own time they were ingenious and clever pieces of mechanism contrived by men of master minds. It is worthy of note

that mining has always been responsible for more than its full share of discoveries and improvements. I might mention for instance the steam engine, locomotive, pump, and many other useful pieces of mechanism, which were first applied to mining operations. The primary method of descending and ascending the shaft was by means of holes cut in the sides, and the mineral was conveyed to the shaft bottom and even up the shaft itself on the backs of the men and women in corves or baskets, for it was not until Parliament prohibited it that women ceased working underground. The first improvement in the shaft was to fix ladders for the workmen to ascend and descend, and the employing of a jack roll in conjunction with a hemp rope for the hoisting up of the minerals; the baskets were superseded by barrows underground, which were run upon planks of wood laid longitudinally in the centre of the road. When two men working the jack roll were found insufficient to raise the necessary quantity of coal, a horse was used for that purpose. A pulley was fixed at the top of a set of shearlegs which were placed over the mouth of the shaft, and another pulley was fastened at the bottom of one of the shearlegs; the hemp rope by which the mineral was raised was affixed to the load at the bottom of the shaft by one end, and the other was passed over the pulley at the top of the shearlegs under the one at the bottom, and then hitched on to a horse; the horse was urged to a trot when the mineral required raising, and was then slowly backed again until the empty corve reached the bottom of the shaft.

Montgolpher invented the first Balloon.

(Continued from No. 8, Vol. 1.)

An ADDRESS by Mr. C. M. PERCY.

Duplicate Fan Engine.—*Contd.*

WELL, as a matter of fact, there is really nothing in a fan, which is simply a revolving wheel, to get out of order. But, a very good arrangement, adopted in at least one case, is to have two fans, each having a seperate engine; one fan always working and one always resting.

General Colliery Machinery.

A very great deal might be said interesting to a mining audience about machinery for pumping, and for hauling, and for winding so as to ensure speed and power and safety, and also to the advantages and disadvantages of compressed air in underground operations. It was impossible in one lecture to say much that would be either interesting or instructive covering so wide a range. He had thought it better on that occasion to confine himself to the chief uses to which coal was applied, and to the machinery now employed to fulfil what was generally admitted to be the first requirement in coal mining operations, namely, the possession of sufficient ventilation. It would be matter for congratulation to the audience and himself if these two points had been comprehensively dealt with. So efficient were modern ventilation appliances that in no enclosed operation or industry was there a better atmosphere or more uniform temperature.

Technical Instruction. What is it?

It might be well to touch upon the subject that had been the special

cause of their coming together that night, viz: Technical Education. For a very long time in their schools and their colleges and their universities, they had spent much money in providing what might be described as a literary and commercial education, but an industrial nation, in an age like the present, require something more. Book writing and book-keeping, although both useful and indispensible, would not maintain a country like England. An industrial education was necessary, an education directly bearing upon the industries, giving skill to the hand and thoughtfulness and inventiveness to the mind. Thorough technical education impressed upon the mind the principles of a trade and industry, and combined with it a skill in their numerous handicrafts. It was that combined knowledge which enabled nations in this age of ever increasing competition to cheapen production, and improve the quality and effect improvements. There was too common an opinion that England took the lead in everything, but, as a matter of fact, so far as technical instruction was concerned, other nations were considerably ahead, and the result was that not only had England to compete, to some extent, on unequal terms in what might be called neutral markets, but foreign productions successfully competed with England on its own soil. Although somewhat late, the nation, through its representatives, had at last realised that something had to be done, and very large sums of money were being set apart for the purpose of providing technical instruction of the best possible kind for the people engaged in every possible occupation. In educational matters England never went back, and it might be taken for granted that not only would the amounts at present available for technical instruction be continuing, but in many cases they would be supplemented by the exercise of the powers already possessed by the various local authorities to levy special rates. All education, technical and otherwise, to be effective, must grow.

Technical Instruction appertaining to Mining.

Mining, the industry with which most of them were intimately connected, owed its present great position to men like James Watt, who gave us the steam engine; George Stephenson, who pioneered and developed the railway system; Sir Humphrey Davy, who gave us the first real approach to a safety lamp; and Guibal, Schiele, and others with their powerful colliery ventilating fans. As time advances greater depths of collieries will bring new difficulties, and necessitate further improvements, such as only technical knowledge of mining requirements can enable us to produce. To the general working miner a technical knowledge of such matters as the variation and influence of the atmosphere, the positions and methods of working of our seams of coal, the character of gases which our coal mines produce, the strata by which our coal seams are surrounded, the measures in which our coal seams are contained, and the appliances in daily use in our collieries, will make him a better miner, and will make his occupation less hazardous.

Technical Instruction valuable to all citizens.

Should the authorities, encouraged by public desire and appreciation, establish some means of instruction in the mining and geology of coal,

they will be of much interest to those who dwell in a mining district, although not actually engaged in mining operations. The history of coal is full of facination, and a study of that history pregnant with information as to the world in which we live and the works in which we are engaged. We are taken back in imagination through millions and millions of years, periods compared to which in point of length our generations and our centuries are only fleeting hours. We study the primeval forests from which under the beneficent influence of the sun our coal has been derived. We come back along the track of countless ages, and study the deposit and formation of our coal-fields. We explore the subterraneous regions and follow the operations of re-producing that deposit of a former time, and placing at the disposal of mankind a material wealth compared with which the fabulous treasures of eastern lands pale into insignificance. We see there the "black diamonds" which by means of furnaces and engines and machines provided nations with employment, and supplied the world with comfort, luxury, and power. Many writers have written as to what they term the secret of England's greatness. The source of its power is coal, and every citizen should know something of the power on which his country depends. Still this address is being delivered, and the efforts of the local authorities are being directed chiefly to those who, being actually engaged in mining operations, are more directly interested.

CONCLUSION.

The amount and extent of this technical instruction will depend on the amount and extent of the appreciation displayed. He was anxious that the County of Lancashire, and especially the mining community of Lancashire should fully appreciate and fully utilise all the advantages that were being offered. This industrial welfare of the United Kingdom depended upon a national and local, thorough, and efficient system of technical instruction.

MECHANICS RELATING TO MINING.

BEFORE we go any further with descriptions of fans, it would be as well to give an example showing how the horse-power of a fan is calculated for given dimensions of fans. We will consider the case of a non-condensing steam engine, and will calculate from the following dimensions. We will take one with 36in. cylinder, piston rod 6in. dia., 4ft. stroke, working 48 revolutions per minute. A cylinder 36in. diameter has an area of about 1018 square inches, and the area of a piston rod 6in. diameter is about 27¼ square inches. This leaves an area upon which steam pressure is exerted of 1018 — 27¼ square inches = 980¾ square inches. We will suppose that the difference between the pressure in front of the piston and behind the piston is 32lbs. on the square inch, this giving a pressure on the cylinder of 980¾ × 32lbs. = 31,384lbs. A speed of 48 revolutions with 4' stroke means 384 piston feet per minute; therefore the total H.P. of the engine is 31,384 × 384 ÷ 33,000 = 365 H.P. But an allowance must be made for the engines running light—say 25 H.P.—so that there will be an effective H.P. transmitted to the fan of about 340. The Waddle Fan resembles in some respects the Guibal Fan, as it also has a very moderate

speed of revolution, and therefore has to be made rather large. The air enters at one side of the fan only, and is what is called open-running, that is to say, it discharges the air all round its circumference. The passages from the centre to the circumference have an easy curve so as to lessen the friction of the air. The special feature of the fan is that its passages from the centre to the circumference gradually lessen in sectional area, so that the velocity of the fan at any point multiplied by the sectional area of the passage at that point may be constant, thus ensuring the fans being full of air. The blades incline backwards, and the whole of the fan revolves, casing, blades, and all. The Sehiele Fan has this great advantage in being small and consequently occupies less space than the other two, and as room at some collieries is of great importance, it follows that at small collieries the Schiele Fan has been very favourably received. The blades incline backwards for part of the length at the tips. The casing is stationary and consists of a spiral leading into an expanding chimney. The blades are constructed in such a manner that the area of the air passages throughout the fan is uniform. Owing to being made very much less in diameter, a fan of say 14' diameter will have given to it from 90 to 120 revolutions per minute. The smaller the diameter the greater must be the speed to place it on a footing with fans of larger dimensions. In the next number I shall go into the subject of winding engines and winding arrangements in general.

Sixty tons conveyed one mile per day is the maximum effect a horse will produce under-*ground.*

ANSWERS TO QUESTIONS

(In No. 12.)

Question 1—What are the Rules referring to doors?

Answer to Question 1—

The Rules referring to doors are the Special Rules 17, 31, 32, 52, and 57. Rule 17 says—That the under-manager shall see that the furnace, fan, or other ventilating apparatus (if any) is in good repair and carefully attended to; and if doors be used in place of stoppings between the main in-take and return air courses, that they are doubled, so that one will check the other; and that all doors are fixed to close of themselves and not to stand open. Rule 31 says—The fireman or other competent person shall see that all doors, brattice, stoppings, and fences are kept in good repair. Rule 32 says—He shall see that all air-doors are fixed in such a manner that they will close of themselves and not stand open, and shall frequently and carefully examine the state of the air-doors. Rule 52 says—Each work-person shall give immediate information to the manager, underlooker, fireman, or other official if he notices any derangement in the ventilation. Rule 57 says—No person, unless authorised to do so, shall interfere with any door, or leave open any door he found shut, or do anything to impede the ventilation of the mine.

BENJAMIN NIGHTINGALE,
Ryhill, Wakefield.

Question 2—When are safety lamps required by the Act to be used?

Answer to Question 2—

In examination of mines the inspection shall be made with a locked safety lamp, except in the case of any mine in which inflam able ga

has not been found within the preceding twelve months. No lamp or light, other than a locked safety lamp, shall be allowed or used in any place in a mine in which there is likely to be any such quantity of inflammable gas as to render the use of naked lights dangerous, or in any workings approaching near a place in which there is likely to be an accumulation of inflammable gas. And when it is necessary to work the coal in any part of a ventilating district with safety lamps, it shall not be allowed to work the coal with naked lights in any other part of the same ventilating district situated between the place where such lamps are being used and the return airway.

SENDIE B. BRAIN,
Rockville, Drybrook,
Gloucestershire.

Question 3—If you found the ventilation in a district slacken where would you look for the defect and how would you remedy it?

Answer to Question 3—

If the ventilation of a district was reduced I should come to the conclusion that one of two things had happened, namely, either an air-door had been left open, or there had been a fall of stone in the airway, therefore causing a greater amount of resistance to be encountered by the current of air passing, which would also mean a reduction in the total quantity. If the open door was the cause I would have it closed, or, if it was an obstruction in the return air-way, I would set the waste men to remove it as quick as possible.

BENJAMIN NIGHTINGALE,
Ryhill, Wakefield.

Question 4—What quantity of air would be required to ventilate a mine with an out-put of 1000 tons a day, and a working face of 1700 yards, and what are the advantages of splitting the air?

Answer to Question 4—

V = Quantity of air required.
M = Number of men underground.
H = Number of horses underground.
P = Pounds of gunpowder used per hour.
A = Average output of coal a minute in tons.
W = Working face in square yards.
F = Factor of Safety.

Formulæ:—$V = M\ 24 + N\ 72 + P\ 192 + F\ (A \times 2{,}700 + W$. Now suppose $M = 500$ $H = 20$ $P = 25$lbs. $W = 3{,}400$ (taking seam as six feet thick) $A = 1{,}000 \div 8 = \frac{125}{60} = 2{\cdot}08$ $F = 4$. Then—

$V = 500 \times 24 + 20 \times 72 + 25 \times 192 + 4\,(2{\cdot}08 \times 2700 + 3402)$
$= 12{,}000 + 1{,}440 + 4{,}800 + 36{,}064.$
$= 54{,}304$ cubic feet per minute.

The advantages of splitting the air are, that the men in each ventilating district have fresh air, also, if a fall takes place in an airway it affects only the district the airway belongs to. Further, if an explosion takes place its effects to a certain extent are confined to the district in which the explosion occurs.

SENDIE B. BRAIN,
Rockville, Drybrook,
Gloucestershire.

Question 5—In visiting a collier's "place" what are the points that would direct your attention?

Answer to Question 5—

In visiting a collier's working place the points I would give my attention to would be to see if the men were working in compliance with General Rules 21 and 22, and also the Special Rules with respect to the timbering of the roof, and also the spragging of the coal and the place otherwise made secure. I would also take

particular notice of the working place and the goaf, to see if there was any fire-damp, CH^4, or other deleterious gases, then, if I found any danger in this respect, I would withdraw the workmen in accordance with General Rule 7, and fence the place off the whole width of the entrance, so as to prevent persons carelessly entering the same.

BENJAMIN NIGHTINGALE,
Ryhill, Wakefield.

Question 8—What H.P. would be required to haul 17 full tubs up an incline of 1 in 4 at a speed of 180 yards per minute, the friction of tubs to be reckoned as $\frac{1}{27}$ of weight?

Answer to Question 8—

Assuming each tub to carry 9cwt. of coals, and each tub to weigh 4½cwt. when empty. First we proceed to find the total load on the rope which is obtained by multiplying the load by the gradient plus the load due to gravity; thus each tub = 13·5cwt., and 13·5 × 17 = 229·5cwt., then 229·5 × 112 = 25704lbs., and 25704 × $\frac{1}{4}$ = 6426lbs. due to gravity; then 25704 × $\frac{1}{27}$ = 848·25lbs. the load due to friction, and 6426 + 848·25 = 7275·25 the total strain on the rope, not including the weight of the rope. Then the total load on the rope, multiplied by the velocity in feet per minute will give the units of work to be done, thus 7274·25 × 180 × 3 = 3928095 units of work to be done. But we must allow for friction due to ropes and rollers. Allowing ·7 for the modulus the H.P. is found thus:

$$\frac{3928095}{33000 \times \cdot 7} = 170 \cdot 04 \text{ H.P. required.}$$

ANGUS McLELLAN,
99, Knightswood,
Maryhill,
Glasgow.

Second Silver Medal Competition.

We have awarded "Diplomas" for this competition to ISAAC SMITH, 13, Hardwick Place, Hunslet Carr, Leeds; and J. DAYKIN, Higher Guerney Villa, nr. Bishop Auckland.

The articles in this competition were not up to the previous competition in merit.—*Editor of Mining.*

We will give a uniform reward of 1s. for the best original answers to the following questions. All competitions are subject to the rules given below:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on one side of the paper only.

3rd—Correct postal name and address must be sent.

4th—They must reach us by June the 13th, 1893.

ELEMENTARY.

Question 1—What are bituminous, free-burning and smokeless coals? Give an example of each.

Question 2—Describe a method of long-wall working on a thin seam with a good roof.

Question 3—What gases are met with underground, and to what extent are they dangerous in the air of mines?

ADVANCED.

Question 4—How would you prove a coalfield by boring for the purpose of fixing the position of a new sinking?

Question 5—Describe some methods of using iron or steel instead of timber in shafts and levels.

Question 6—Describe in detail some form of underground pumping engine.

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MINING

A Journal devoted to the interests of Mining.

No. 15. Vol. I. JUNE 15, 1893. FORTNIGHTLY ONE PENNY

MINING NEWS IN GENERAL.

The Hall devoted to mines and mining at the World's Fair is of enormous size, being no less than 700 feet long by 350 feet wide, and the cost of its erection has been £50,000. Beneath this vast hall every known mineral, and the numerous appliances employed in the getting of the same, are exhibited. The method of timbering coal and other mines is shown by examples, and there are specimens of underground chutes, gates, and appliances for delivering the ores; also ventilating, lighting, and signalling. All the different descriptions of boring tools, pumps, wagons, rails, screens, etc., will be represented. A valuable collection of works referring to the history and literature of mining and metallurgy, maps, relief models, charts, diagrams, and a very complete library of mining and metallugrical literature. In fact, nothing has been neglected by the Directors of the World's Greatest Show to convey to the spectator's mind, as thoroughly as theory will allow, the manner in which every mineral is obtained, dressed, and transported from its original bed to the surface of the earth.

***

The Chicago Fair will indeed be wonderful for its many novelties, extraordinary appliances, and the hugeness of everything undertaken. The wary managers knowing full well the cost which would be entailed if all the buildings were painted in the orthodox fashion of hand and brush must needs invent a machine to curtail expense. The paint flows through hose pipes, at the end of which is a nozzle. This is held by a man and directed against the wall which requires painting. Indeed, one might suppose the man was trying to extinguish some imaginary fire. The amount of paint used is slightly in excess of that used by hand for the same amount of painted surface, but one man directing a nozzle can do as much work as ten men painting with brushes.

***

A bridge of aluminium has been proposed to be built across the straits of Gibraltar, and the project is being scientifically discussed.

The first steam lifeboat built for the National Lifeboat Institution was recently tested on the Mersey. The description announces that the pumping machinery gives motion to the vessel by ejecting water from four turbines at the side of the vessel. That it is expelled at the rate of a ton per second and propels the vessel at the rate of nine knots.

***

At the Wigan Police Court on June 2nd, William Bennett, an engine-winder, and Simon Battersby were summoned for contravening the C.M.R.A. On the 19th ult., the defendant Bennett was found on duty at the Abram Collieries in a state of intoxication, the first intimation being the rapid running of the cages. Simon Battersby, the man whom Bennett relieved, was charged with permitting the defendant to go on duty under the influence of drink.—A fine of 20s. and costs was imposed in the first case, and 40s. and costs in the second. The Magistrates contending that Battersby was to blame for allowing the other defendant to work. The fines were very proper, for it was indeed a serious affair.

***

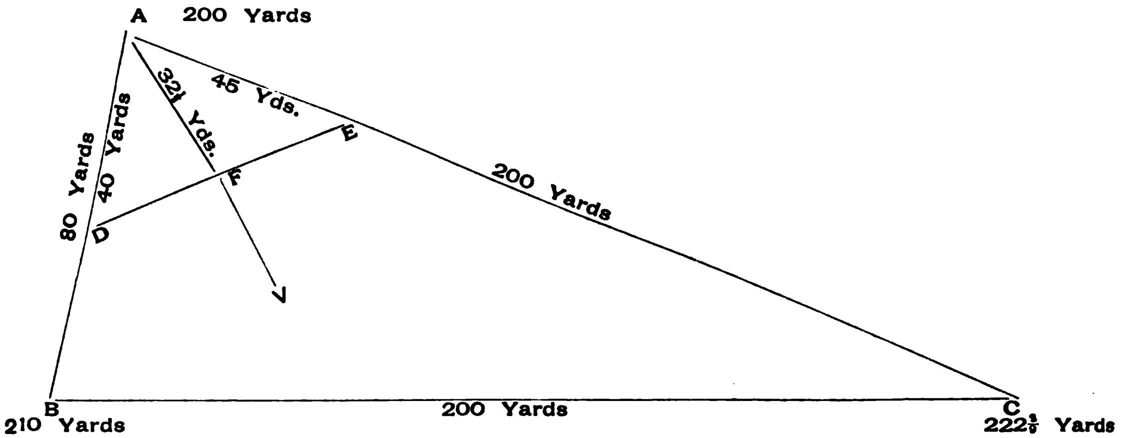
The *Engineer* quotes from an American contemporary, but doubts the veracity of the following :—" The Empire State express running between Rochester and Buffalo on May 9th, performed the journey, a distance of 69 miles, in 68 minutes, including a stop at Batavia, and one mile of the journey was traversed in 42 seconds, and another in 35 seconds, or at the rate of 102 miles per hour." The Yankee deserves a special mark of merit for this.

***

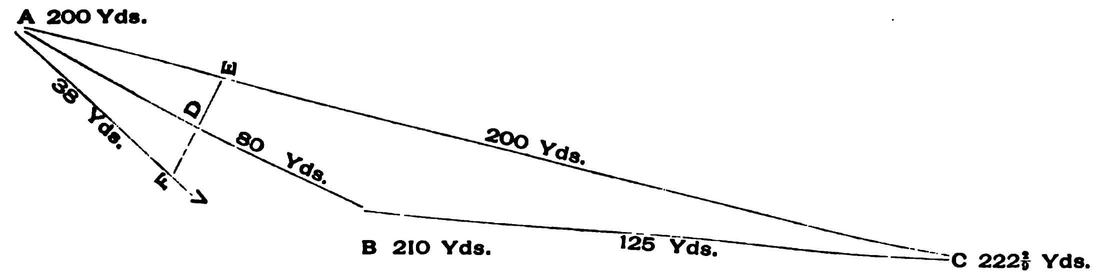
It is proposed to import anthracite coal from America to be used in London, as it would materially decrease the density of the fogs so prevalent there. It has been stated that the cost of conveying the coal from America would be very little more than the railroad charges from the North. Of course the Welsh anthracite coalfield is not sufficient to supply London with fuel for any length of time, so we must rely upon America if anthracite coal is to be used extensively at home.

INCLINATION OF SEAMS.

If three boreholes be put down to prove an area of coal at the points A, B and C, and the seam is proved at the respective depths given in sketch, the distance between boreholes being also given, in what direction and at what rate is the maximum dip of the mine, supposing that there are no faults occuring between the boreholes ?



The borehole A is 200 yards deep, B is 210 yards, and the distance between them is 80 yards. Therefore the seam dips 10 yards in 80, or 1 in 8 in direction A B. Again, the depth of C is $222\frac{2}{9}$ yards, and the distance from A to C is 200 yards. Therefore the seam dips $22\frac{2}{9}$ yards in 200, or 1 in 9, in direction A C. The level of the mine will now be found by measuring with a scale eight parts along A B, beginning at A, and nine similar parts along A C. The points on sketch are shown at D and E, but instead of measuring 8 yards on one and 9 on the other, I have taken 40 and 45, and as these are in the proportion of 8 and 9, the result is the same. Now as the dip in direction A B is 1 in 8, therefore in 40 yards the seam will have dipped 5 yards. Again, the dip along A C is 1 in 9, therefore in 45 yards it will have dipped 5 yards. From this we see that the points D and E are both 5 yards below A, vertically; therefore a line joining these two points must be the level of the mine. Now drop a perpendicular from point A to cut line D E at F. It is evident that this line A F is the direction of the maximum dip. To find the rate of dip in this direction, measure with the scale with which the plan has been made (in this case 40 yards to an inch), the distance from A to F, this is $32\frac{1}{4}$ yards. From previous work we saw that the seam at D and E was 5 yards deeper than at A. Therefore the point F is 5 yards below A. The distance from A to F was measured as $32\frac{1}{2}$ yards. Therefore the maximum dip is 5 yards in $32\frac{1}{4}$ yards, or 1 in $6\frac{1}{2}$ In this example the direction of the maximum dip of the seam is between A B and A C. We will now take another example where the line of maximum dip will be outside the triangle.



As can be seen from the second figure, the depths are the same, but the angle B A C is considerably less. The dips between the bore-holes are the same, so we again measure 40 yards along A B, and 45 along A C. The points D and E are joined, and the line will have to be produced on the side of D, for the perpendicular dropped from A will cut this line at F. The distance between A and F is again measured, and in this case is 38 yards, so the dip is 5 in 38, or 1 in 7$\frac{3}{5}$. The reason for choosing the lengths 40 and 45 to find the level was to make the triangle sufficiently large to work with, for if 8 and 9 were used the triangle A D E would be very small. In the same manner, any multiples of 8 or 9 can be used, 16 and 18, 32 and 36, 80 and 90. I have chosen the depths and distances apart so that they would work out easy and not serve to complex the question.

SOUTH WALES COALFIELD.

THIS Coalfield is a very important one and is the second largest in Britain. In form it is like a trough. The beds rise and crop out towards the north, and the Millstone Grit and Carboniferous Limestone come in. It is divided into two portions by the Carmarthen Bay. That portion to the east of the bay extends for a distance of 56 miles. That on the west extends to St. Brides Bay, a distance of 17 miles. The eastern portion is traversed throughout by an anticlinal axis which brings a considerable area of the lower seams within reach of mining operations. A remarkable change takes place in the coal of this field. While in the eastern portion the seams are bituminous, in the centre of the field they are semi-bituminous, and in the western part they change into anthracite. The most valuable seams are those at the top and bottom; the central portion is of poor quality. All the large faults range in a N N-W direction, and are remarkably parallel to each other. The following are Mr. Hall's calculations as to the resources of the coalfield:—

Superficial area of basin, 906 sq. miles.

Greatest thickness of coal measures 12,000 ft.

Number of coal seams of two feet and upwards 25, giving a thickness of about 84 feet of workable coal.

Total quantity of coal in 1870 down to 4000 feet of depth, 32,456 millions of tons.

Quantity available for future use after making deductions of amount of coal got since 1870, 32,166 millions of tons.

The quantity of coal raised in 1878, in this coal basin, was 17½ million tons from 662 collieries. At this rate of production the supply is sufficient to last for about one thousand eight hundred years.

MECHANICAL APPLIANCES.

AT the Mains Colliery, Bamfurlong, near Wigan, two mines are worked from one shaft. To obtain a close connection with the cage at the top mine a special contrivance is employed instead of the old hinged piece of timber or iron. It consists of a movable table composed of iron plates fastened firmly together to form a staging of about three yards square. This stage is fitted with wheels which run along a length of rails similar to the traverse table of a sinking pit. One of these tables are fitted to each side of the shaft and is worked by a small engine using compressed air fitted in a convenient corner of the pit eye, and manipulated by the winder from the surface by a lever placed in the engine-house. The connecting rod is fitted to a lever, which gives the tables an inward or outward motion as required. The arrangement is similar to the working of the supporting catches for the cage on the pit brow. The distance traversed by the table is about 8″ Immediately the cage is stopped the winder by means of the lever allows sufficient compressed air to enter the cylinder of the engine to move the piston forward which works the tables inward to the cage. The tubs are exchanged, and the signal being given the table is run in the opposite direction by the engine-winder pushing the lever back to its original position, which allows the air to act on the other side of the piston and force it back. To prevent the winder from starting the engine before the tables are pushed back from the cage an indicator is put in a prominent place to show him the position of the tables. As before stated the movement being only 8″, a little experience soon enables the hooker-on and the workmen generally to become accustomed to the motion of the tables, and they proceed with their work without suffering any inconvenience from it. The outbye end of the table slides under landing plates, which are thinned down at the end so that the empty tubs can be easily pushed from the table to the rails. Altogether the arrangement is a good one and involves little trouble. Some people contend that the engine-winder has sufficient to look after with his engine. That his work requires his whole attention is granted; but as the sum total of operations in this appliance is the working of a lever, I do not consider that it is sufficient to prevent him from working his engine in a proper manner.

GRAVITY.

GRAVITY or gravitation is a very important natural force, without a knowledge of which no mining student can be expected to excel. Its laws take such a prominent part in scientific mining, that a thorough knowledge of its influence and effect is absolutely necessary. Gravity is the earth's influence or attraction over other bodies, and which causes *weight* and draws all bodies to itself. It attracts every *particle* of every substance with an equal amount of force, hence, if a body, bulk for bulk weighs three times as heavy as another substance, it must contain three times the number of atoms in the same volume. To simplify the matter a little more, the sp. gr. of water is taken at one, and that of coal at, say 1·25, which is to say, that volume for volume coal is 1¼ times as heavy as water, and contains 1¼

times the number of atoms in the same space. The seat of gravity is in the centre of the earth, and manifests itself in every direction. That this must be so will be patent to every casual observer, because, the people of New Zealand, living in the Antipodes, have their feet to our feet, hence, when they throw a stone into the air, it is descending from *our feet*, yet it is attracted back to theirs. Gravity is subject to the law of squares, that is, its influence decreases with the square of the distance. We will suppose we weigh on the surface of the earth by means of a spring balance, a substance, and find it weighs 10lbs., and then weigh it again on the top of a mountain five miles high, we shall find it has decreased in weight. Thus, suppose the radius of the earth to be 4,000 miles, its weight will be found thus $4005^2 : 4000^2 :: 10 : 9{\cdot}975$. On the other hand, if it were possible to descend to the bottom of a shaft five miles deep, and there weigh a substance which on the surface of the earth weighed 10lbs., we should find it weighed more than 10lbs. It would weigh 10·025lbs., thus

$$3995^2 : 400^2 :: 10 : 10{\cdot}025.$$

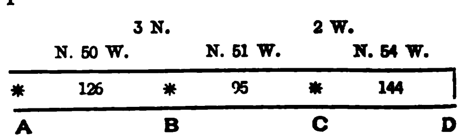
Thus, I think we have conclusively proved that gravity is the influence which induces weight. Gravitation is, practically speaking, the only force which we, horses or engines have to overcome. That is, apart from friction. Our next duty is to point out the relationship that exists between gravity and falling bodies, and for this purpose I shall quote the three laws of motion as enunciated by J. Todhunter, M.A. First law of motion:—Every body continues in a state of rest, or of uniform motion in a straight line, except in so far as it may be compelled to change that state by force acting on it. This law simply declares the inertia of matter, or after a body has had a given motion imparted to it, it will continue to move until brought to a state of rest by friction or other external force. Second law of motion:—Change of motion is proportionate to the acting force, and takes place in the direction of the straight line in which the force acts. Third law of motion:—To every action there is always an equal and a contrary reaction: or the mutual actions of any two bodies are always equal and oppositely directed in the same straight line. These three laws of motion originally founded by Sir I. Newton, cover every kind of motion, however produced, whether by mechanical or natural force. FALLING BODIES.—Careful experiments made by scientists tell us that the distance travelled in one second of time by a body falling freely through space is equal to 16·1 feet; that is if the body starts from a state of rest and is acted on by the attraction of gravity alone. Also a body is uniformly accelerated to its journey's end. This will be better understood by working out a few examples:—What would be the velocity of cage when it reached the bottom of a pit, if the rope broke when 200 yards from the bottom? Formula—8·02 times the square root of the height in feet will give the velocity with which the cage would strike the bottom, thus $\sqrt{600} \times 8{\cdot}02 = 196{\cdot}41$ feet per second, nearly. Again, how long would the cage be in falling the above distance? Formula—extract the square root of the quotient of the height in feet by 16·1, thus $\sqrt{\frac{600}{16{\cdot}1}} = 6{\cdot}1$ seconds.

Suppose a winding cage was travelling at the rate of eighteen miles an hour when the detaching hook entered the ring, how high would the cage continue to rise after the rope was detached, supposing there were no impediments in its path? Answer: According to the laws of falling bodies, it is found if a body is projected upwards with a given velocity it will first come to a state of rest, then start its downward motion, and at the moment when it strikes the earth it will have the same velocity and momentum with which it was projected upwards. Hence, if we know how to find the velocity per second of a body after it has travelled a certain distance in a downward direction, we may, by reversing the mode of operation, find the height to which a body will rise if projected upwards with a given velocity. To answer this question we must first find the velocity per second, thus $\frac{18 \times 1760 \times 3}{1 \times 60 \times 60} = 26{\cdot}4$ feet. Then reversing the formula already given, we get $\frac{(26{\cdot}40)^2}{(8{\cdot}02)} = 10{\cdot}824$ feet. In these examples all resistances are neglected. By means of gravitation disused pits may be approximately measured, all that is necessary being care and a good stop watch. Let it be assumed that we wish to know the depth of an old pit, and that we have no means at hand to measure it, except a watch and a stone, and the pit may be approximately measured as follows:—Stop the watch and mark the position of the second hand very carefully, hold the watch in your right hand and in your left a stone over the pit mouth, the instant you let the stone fall down the pit, start the watch, and listen attentively for the stone *striking the bottom*, then stop the watch again and count the number of seconds the stone has been in falling, which we will suppose is five seconds, and by reversing the formula already given, we may find the depth of the shaft, thus $52 \times 16{\cdot}1 = 402{\cdot}5$ feet. Of course, the time could be told by any watch which had a second hand. To find the space passed over by the stone, or the depth of the shaft in the last example, the resistance of the atmosphere and the time it took the sound to travel to the operator are neglected. From what has already been said respecting the uniform accelerating velocity of a body falling freely through space, it will be evident that during the last second of its flight it will travel considerably further than during its first or second.

(To be Continued.)

SURVEYING.

LOOSE-NEEDLE Surveys can be made without the necessity of removing the iron rails, &c., which disturb the needle, except in the first instance, though it is advisable to have a sight both at the commencement and end of the survey when there is no local disturbance, or in default of this a datum line from the pit will be sufficient. The method of procedure is very simple, and will easily be understood by those who have previously mastered the difficulties of loose-needle surveying. We will refer to the accompanying diagram to help us with the explanation:—



Let us grant that a bearing can be taken at A without the needle being subject to any disturbance. The dial is fixed at A, and the bearing towards B taken. Let this be N. 50 W. Now this is the true bearing of A B, and is booked accordingly. The dial is next fixed at B (without removing any iron that may happen to be about), and a sight is taken back to A, and the bearing read off. This reads N. 47 W., while the correct bearing as before ascertained was N. 50 W. Thus it is plain that the north end of the needle is attracted 3° N., or to the left. Next a sight is taken in direction C without moving the dial, and the bearing is taken and found to be N. 48 W. Now as the needle was attracted 3° N., it is evident that the correct bearing is $48 + 3 =$ N. 51 W. The dial is now taken up and fixed at C, and the back sight towards B is taken. This reads N. 53 W., and as the correct bearing is N. 51 W., this shows that the amount of disturbance is 2° W., or right. The foresight to D is next taken and reads N. 56 W., and as the needle has been attracted by local disturbances 2° W. the correct bearing must be N. 54 W. If it were convenient to take a sight from D to C without the needle being disturbed it should read N. 54 W., and this would act as a check on the whole survey. The numbers 126, 95 and 144 are the measurements between the stations. To attain any degree of accuracy it is necessary that the dial be fixed as nearly as possible in the same place as the light previously looked at. The best method of doing this is to have three sets of legs for the dial. One set is sent ahead for the foresight, and one remains behind for the back sight. A metal cup, fitted with two levels fixed at right angles to each other at the bottom of the cup, is fixed on the legs at the foresight. The socket joint of the legs is made to assume a true perpendicular direction by the adjusting of the levels in the cup. The lamp is then placed in the cup which is just large enough to admit of the bottom of the lamp being put in it, and by this means the centre line of the light of the lamp is exactly the same as that of the dial legs. The legs at the back sight have a similar cup minus the levels, the levels not being necessary, because they have been previously levelled with the dial. When the back sight has been taken the legs are sent on ahead to be fixed for another sight while the foresight is being taken. The dial is then removed to the set of legs which originally formed the station for the foresight, and a bearing is taken back to what were originally the centre set of legs. By working in this manner the exact place is kept from time to time. If three sets of legs are not attainable two sets may be used to the same advantage, the only difference being that it will require a longer time, as you will require to wait for the legs being brought from the backsight before the foresight can be taken. Another method, though not quite as accurate, is to suspend the lamp from the roof by a string, make a chalk mark at the place, and then use a plumb to fix the dial in its proper position. This method possesses the advantage of only requiring one set of legs, but it takes a considerable time to place the dial exactly under the mark with the plumb bob.

A cubic foot of water = 1000 oz., or 62·5 lbs.

One gallon of water weighs 10 lbs.

A circular inch is a circle having an inch for its diameter; and is equal to ·7854 sq. inches.

SEARCH FOR COAL.

IF it be suspected that coal will be found under certain lands; there are many things to be considered and many observations to be taken before the actual sinking of the shafts. The all important question to commence with is, will it pay supposing coal of average quality and thickness be found? Before this question can be answered many facts which rely principally on local conditions must be looked to. Among others I may state the following:—Is labour cheap and are there plenty of workmen to be had? Is the estate in a convenient position for the conveyance of the coal to a place of sale? For if several miles of railway require making the cost of same may materially lessen the probability of working the mines from a remunerative point; or the mineral may require carting for a considerable distance. Again, is there a market for the coal at a sufficiently close distance, or how far it will it pay to send it? These points require to be considered with the utmost care, and the calculations of the probable cost, etc., worked out. Of course the calculations will not be as correct as they might be, for everything is supposition until more is known of the estate; but they can be altered from time to time if necessary as fresh information is received. A few pence per ton difference in the price of the coal may mean the difference of the colliery being a source of profit or otherwise. We will assume that the questions so far can be answered satisfactorily; the next thing required is to prove the existence of coal. Now the first proceeding is to obtain all the reliable geological information possible of that district, and to study the same minutely, allowing for any possible geological phenomena that may be in the locality. If the result of such investigations point to the probability of coal existing in the neighbourhood we must proceed with the search. But if the evidence given tends to prove the absence of the carboniferous formation it would be useless to continue.

What we might call the actual search for the coal is the next step. All the surface of the estate must be traversed over and inspected, ever on the alert for the outcrop of a seam, or fossils allied to the coal measures. Railway cuttings, quarries, stream courses and excavations of all kinds must receive special attention. A careful examination of pebbles, etc., in the beds of the streams is invaluable, as something may be found which is characteristic of the coal period. The distance any such fragment has been carried down the stream by the flowing water may be approximately determined by its worn appearance considered with its hardness and its size. There may be small grains of coal which have in all probability been washed from some outcrop, and by following the stream up in the direction of its source the outcrop may possibly be found. The direction and rate of dip, which is a piece of valuable information, can usually be learned from the strata laid bare by the cuttings. A pocket clinometer is useful on such explorations. Ploughed fields sometimes show indications of the outcrop of a mine in the appearance of a black streak along the line of outcrop. If such an occurrence happened it would be advisable to dig a pit a few feet in depth so as to pass through the surface soils to the regular strata and most likely the outcrop will be found. If the field is partially proved by other collieries or borings in the

neighbourhood, a hasty conclusion must not be drawn that because it is a workable seam in another part that it will be under the estate in point; for there may be many causes to render the field unvaluable. The seams may be thrown down by a fault, or faults, to a depth beyond the practical limit of working. The coal measures may have dipped beneath other formations beyond the limited depth. The seams may thin out, the quality of the coal decrease in value, or the seams may have cropped out to the surface. Whether the seam has cropped out or no should be ascertained by surface prospecting, also taking into account the depth and inclination of the neighbouring colliery. The same thing may be said of its dipping under newer formations. But for the other causes, they can only be proved by actual boring. The common method of rod boring has been discussed in previous numbers of this journal, so we will describe and illustrate the newer kinds of boring appliances.

(To be continued.)

PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. Any competitor may answer any number of questions subject to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by June the 22nd, 1893.

Question 1—Describe the terms, Chert, Gneiss, Mica-Schist, Tuff.

Question 2—What thickness of cast-iron tubbing would you use in a shaft 18 feet diameter and 80 yards deep?

Question 3—An airway passing 40,000 cubic feet of air per minute is split in two, one measuring 6′ × 5′ × 1,500′ long, and the other 10′ × 6′ × 2,400′. How much does each split pass?

Question 4—Three levels are being driven simultaneously to open out a colliery, the lower level being the waterway. Describe with sketch how you would ventilate same.

Question 5—If a winding engine is drawing from two pits of different depths. No. 1 pit is 240 yards deep, and No. 2 is 180 yards deep, and the drum of No. 1 pit is 10 feet diameter. What will be the diameter of the drum of No. 2 pit?

Question 6—What operations are performed in searching for a mineral vein?

Question 7—State the use of compressed air as a motive power in mines, the principle of an air compressor, and how the power is applied. Is it economical or otherwise?

Question 8—Give a detailed account of the treatment of wire ropes.

Question 9—What are the advantages of dynamite over powder. What special methods are required to develop these advantages, and what are the special dangers to be guarded against in its use. Give its composition?

SECOND SILVER MEDAL COMPETITION.

In answer to several inquiries, we may say that there was no Medal awarded in the Second Competition. The Articles were not up to the mark, neither were they so neat as in our last competition.

EDITOR.

ANSWERS TO QUESTIONS

In No. 13.

Question 1—What kinds of metallic ores and other useful minerals are usually found in stream-works or alluvial deposits?

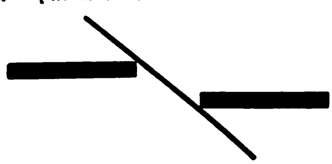
Answer to Question 1—

Gold is found in alluvial deposits, such deposits consisting of the debris of the wasted schistose rocks, and the veins that traverse them. The particles of the alluvium seem to have been transported for considerable distances by the agency of water, because the particles of gold are all water-worn or rounded like pebbles, ranging in size from microscopic particles up to nuggets which weigh one thousand or more ounces. The gold found in the alluvium is called "placer" gold, and is found in the Tertiary and Post Tertiary periods in California and Australia. Stream tin is found also in alluvial deposits, there also being accumulations of fine black tin, and stony particles carried down the mountain sides by cascades and deposited in river gravels in the lowlands at the foot of the mountains. Stream-works are found in the Post Tertiary period in Cornwall and Malacca.

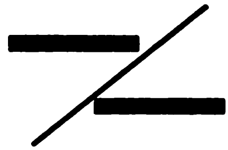
J. T. BRADWELL,
Campbell Street,
Tow Law,
Co. Durham.

Question 2—When a coal seam is cut off by a fault, what operations are necessary to prove the throw?

Answer to Question 2—



Ordinary fault.



Overlap fault.

The most practical way to prove the throw of a fault is to drive on the side of the greater angle, that is, if the fault appears in the bottom first, it is an almost sure sign that the continuity of the seam is on a higher level, and if the fault is first found in the top, it is most likely that the lost part of the seam is down on a lower level. This has proved to be the case in about 80 per cent. of the faults that have been met with up to the present time. Reasoning thus, a bore-hole may be put down without striking the seam at all. There is however an exception to this rule, by the existence of overlap faults, or reverse faults, which change the seam in such a manner that one part of the seam overlaps the other, and a bore-hole may be put down in this case to strike the seam twice. These faults are most frequently met with in the Forest of Dean. If the continuity be not found in a reasonable distance it is best to commence a bore-hole in the opposite direction.

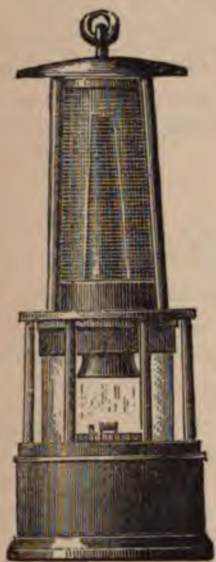
JOHN N. WARDELL,
2, Brown's Buildings,
Crow Hall Lane,
Felling, Co. Durham.

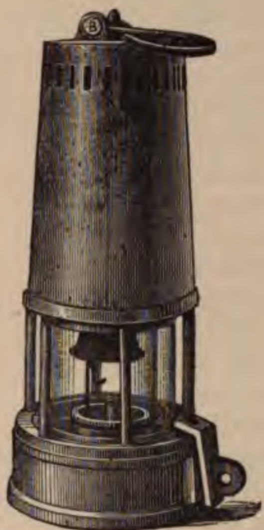
Question 3—Describe the principle of the safety lamp and the construction of one of the safest forms.

Answer to Question 3—

The principle of safety in the safety lamp is found in the property the wire gauze possesses in reducing the temperature of flame below that

of ignition. The wire gauze has a mesh of 784 apertures to the square inch, and the clean iron wires rapidly dissipate heat when flame comes in contact with them. The Mueseler lamp is an improved Clanny lamp with certain additions; it has a conical chimney supported in a wire gauze diaphragm above the flame, all the air to feed the flame has to pass through the diaphragm down the outside of the conical chimney to the light, and the products of combustion pass up the chimney and out of the lamp by apertures at the top. This lamp goes out in the presence of fire-damp, as with an increased flame the chimney is not large enough to carry off the products of combustion, hence they extinguish the light. When bonneted this lamp can stand a velocity of 40′ per second. The illustrations show the Mueseler lamp with and without the bonnet—





ROBERT DAVIDSON,
12, Grange Villa,
Nr. Chester-le-Street,
Durham.

Question 4 — What weight of material would be excavated per 100 yards in a pit 16′ in diameter?

Answer to Question 4—

The weight of material that would be extracted from the shaft may be calculated as follows:—

$16^2 \times \cdot 7854$ = area of pit.

$16^2 \times \cdot 7854 \times 100 \times 3$ = number of cubic feet in excavation.

Now take the specific gravity as 2, and as water weighs 62·5lbs. per cubic foot: the weight of the material per cubic foot $= 62\cdot5 \times 2$.

This will give the answer in lbs. $\div$ 2240 = answer in tons.

Thus—

$$\frac{16 \times 16 \times \cdot 7854 \times 100 \times 3 \times 62\cdot5 \times 2}{2240} = 3366 \text{ tons.}$$

J. N. WARDELL,
2, Brown's Buildings,
Crow Hall Lane,
Felling,
Co. Durham.

Question 9—Describe Mr. Moore's system of hydraulic transmission of power from surface to pumps underground.

Answer to Question 9—

In this arrangement two columns of water are substituted for the ordinary pump rods, advantage being taken of the fact that water is incompressible. The arrangement is as follows: At the steam engine there is a hydraulic cylinder, in which works a piston or ram that receives its motion from a crank driven by the steam engine. At the pump there is also a similar cylinder, and in this, as in the other, there is a piston or power ram. This, however, is attached to the plunger of a double-acting pump. Two columns of pipes, $3\frac{7}{8}''$ bore and $\frac{7}{16}''$ thick, are made to communicate with opposite ends of the cylinders containing the power rams. Now, when both pipes and cylinders are filled with water, and the hydraulic power ram is moved by the engine from one end of the cylinder to the other, the water is forced down the power pipe into the other end of the cylinder containing power rams, thus forcing back this ram also and carrying the pump piston or plunger with it. When the reverse stroke is made they move in the opposite direction, and the pump plunger is moved backwards and forwards in the same way as though it were done with rods or spears. Provision is also made for leakage by placing a tank above the level of the highest point of the power pipes, and on the end of each pipe a valve opens inward, so that when the engine moves the power ram in the cylinder next the engine from one end to the other, water can run from the tank into the pipe, and when moving in the opposite direction water can run in the other power pipe. The stroke of the pump is regulated in like manner by an automatic arrangement of levers working tappets, which are so adjusted that when the piston or plunger passes the ordinary stroke the tappet strikes the lever and opens the valve, etc., as required, thus regulating the stroke. Efficiency 65 %. Total cost about £2,750, including engine, etc.

THOMAS WALLETT,
Heworth Colliery,
Felling, R.S.O., Durham.

*THOS. WINLOW,
No. 18, Fourth Street, Heworth Colliery,
Co. Durham.

ARTICLE COMPETITION.

A prize of half-a-crown is given each issue for the best essay received. To contain between 1,000 and 1,300 words. Not only is original matter required, but also original subjects. Unless the essays are of sufficient merit this prize will be held over.

The rules relating to the Question Prizes, also apply to this competition.

CORRESPONDENCE.

136, Campbell Street,
Riccarton,
Kilmarnock, June 5th, 1893.

(*To the Editor.*)

Dear Sir,

I have much pleasure in writing to say that I am now in receipt of the Silver Medal, which arrived here all right, and I thank you very much for the beautiful article sent. A great many people have already seen it, and all seem thoroughly pleased with its genuine appearance.

I remain, dear Sir,
Yours respectfully,
WILLIAM SHEDDEN.

Printed and Published by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

MINING

A Journal devoted to the interests of Mining.

No. 16. Vol. I. June 29, 1893. FORTNIGHTLY ONE PENNY.

GENERAL INFORMATION.

We are sorry to record a sad accident which occurred at Manner Colliery, Ilkeston. A man named David Tatham and his grandson, were proceeding to work, when they were suffocated by the fumes from a gob fire, and were found in the roadway quite dead some hours later.

***

The Editor of the Colliery Engineer, Scranton, Pa., U.S.A., has kindly forwarded to us several numbers of his valuable paper. For the information of our readers I may state that it is an illustrated monthly Journal of Coal and Metal Mining, and contains lectures on Surveying, Ventilation, Prospecting, Method of Working Coal, and many other subjects equally valuable to the mining student, written specially, by some of the ablest men, for its pages. Altogether it contains 28 large pages of closely printed matter, and to advanced students is well worth the price of 2 dollars 50 cents, for which it will be sent post free for one year.

***

At the Chicago Exposition an obelisk of coal and slate rising to a height of 53′ 6″, measuring 10′ across the base and 4′ across the top, is being exhibited. It bears the following inscription:—

Anthracite Needle,
Showing a Vertical Section of the Mammoth
Vein as it appears in the Mines of the
Lehigh Valley Coal Co.,
upon lands of the
Girard Estate,
Schuylkill, Co.,
Penn'a.

The cost of erection has been 10,000 dollars. This huge column has not been mined in one piece, but has been so skilfully cemented and fastened to iron framework, that it can scarcely be detected. Each layer of coal or shale is shown as it appears in the mine. It contains collectively 32′ of coal, the remainder being represented by shale and bony coal.

During the month of May, 311 accidents causing 69 deaths and injuries to 267 miners, were reported; of these, 280 miners were killed or injured in England and Wales, 56 in Scotland and none in Ireland. Thirty-one convictions have been obtained under the Mines Act, viz.:—5 against owners and managers, and 26 against miners; also 21 mines have been opened and 10 closed.

***

On April 15th, Mr. Frank Scudder attended at the Mitchell Mains Colliery, South Yorkshire, and made some interesting experiments to ascertain whether the vast quantity of shale which is daily brought up out of our collieries could be put to practical use for making gas. From his experiments it appears that the shale gives as a product 34 % of generator gas and 92½ % of water gas, while ordinary coke gives only 30 % of generator gas and 93 % of water gas, the volume thus being most favourable to that which has always been treated as waste. The whole of the colliery premises are lighted by gas made from the shale, and it is intended to effect a still further economy by using the generator gas for heating the boilers.

***

Invention states that a suggestion for improvement in prison constructions provides for cells built of iron or steel pipes which intercommunicate, so that water may be kept under pressure in them. If any attempt be made to break into or out of such a cell, the smallest puncture in a pipe will cause a leak, and give instant warning to the authorities by means of an electric alarm. It would be interesting to know how the future Jack Sheppard will escape from such a scientific prison as this.

***

The next issue of this Paper will contain some great improvements. Do not miss it.

BORING.—Diamond Boring.

I E usual kinds of borers are percussive; he diamond borer is e rotary type or works vay through the strata abrasion. A series of ll diamonds are fitted the lower edge of a llow tube, which is known the crown; and this forms e cutting part of the arrangement. The diamonds re placed in holes prepared in the soft wrought-iron of which the crown is made, and the edges of the hole are drawn down by means of a punch to keep the stones in position. Black Brazilian diamonds are used because they are not so expensive as the rare diamonds, and are not as liable to breakage; one of these diamonds, if only the size of a pea, is sufficient to cut a hole in sandstone half a mile deep without sensible abrasion to its surface. It is evident from the foregoing that diamonds are applicable and efficient for boring, though the idea seemed at first to be ridiculous. The bottom of the crown as may be seen by the figure is made slightly larger in diameter than the core tube, etc., so that the latter can revolve freely in the hole; round the bottom of the crown are a series of vertical holes, to allow the passage of the water which ...d to free the debris

Immediately above the crown is fitted a core clip composed of an expanding steel wedge ring to prevent the solid core cut by the diamonds from falling out again when once it has passed up the hollow tube. The core tube is secured on to the core trap, and is composed of wrought-iron; it consists of two or more lengths, depending on the hardness of the strata being cut through. In hard rock a core tube of about 30′ in length is used; it is expedient to have the cores as long as possible, as it requires considerable time to raise and lower the boring tubes. The top of the core tube is closed with the exception of a threaded opening, into which smaller hollow boring tubes are screwed; above the core cylinder is another tube of the same diameter, left open at the top—this is called the sediment tube. A stream of water under pressure passes down the boring tubes, down the sides of the core, clears the loose sediment from the bottom of the hole, and forces it up the outside of the core tube; when the pressure of water is relaxed, the slime would fall back to the bottom of the hole again and clog the boring crown, were it not for the open sediment tube which collects it. An improvement has been made in

the shape of a conical splash, which is fixed at the top of the core tube; this prevents the force of the water from acting directly on the top of the core, and in soft strata washing it away by conducting the water to the sides of the core trap. The boring rods are carried to the surface and the rotary motion of the diamonds is obtained by means of mitre gearing, and is worked by a steam engine. The tool makes between 200 and 300 revolutions per minute, and thus a circular core is cut, which passes up the core tube and is held in position by the core trap; unless the core is soft it will not break until the act of raising the rods causes it to part at the base. In large boreholes by this process, it is possible to obtain 100 % of cores of the strata if the rocks are moderately hard. For hard rocks the diamond borer is undoubtedly the best, but it is of little service in soft material; the ordinary method being quite as efficient if not more so. In case soft strata is met with whilst boring with diamonds, the crown is taken up and ordinary percussive boring tools employed until such time as hard rock is again encountered. The diamonds though suffering little wear are constantly being lost through breakage, or becoming loosened from their bed, and this item is one of considerable cost. The size of the hole may be anything between a few feet and an inch, depending on the depth of the bore hole required, as the hole is made smaller and smaller as it becomes deeper. The following are some of the advantages claimed for this system:—

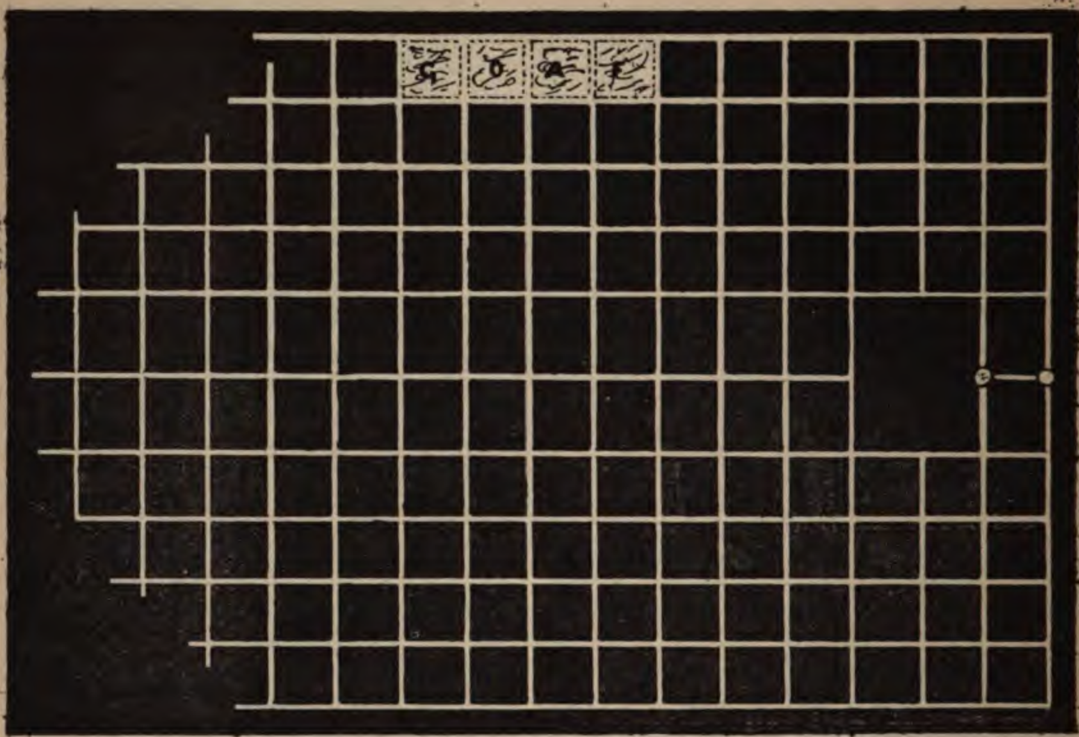
(1) Quick and reliable.
(2) The borings are truly circular, and indicate more clearly than by any other method the nature and thickness of the strata passed through.
(3) The holes are perfectly straight, and can readily be lined.
(4) There is no limit to the depth of boring, as holes of over 4,000′ have been put down by this process,
(5) The boring can be made large for wells or small for mineral prospecting.
(6) Cheaper, if the rocks to be bored through are hard.
(7) If the bore hole is sufficiently large the rate of dip of the strata may be ascertained.

A boring for salt near Mecklenberg, was put down by the diamond borer to a depth of nearly 4,000′ and completed within six months. Not only is this boring remarkable for the rapidity with which it was put down, but also yielded 100 % of cores. One specimen of rock salt being over 20′ long. A boring of this depth performed by percussive boring tools would take at least six times the period, and the information obtained would not be near as positive.

METHODS OF WORKING COAL.

Bord and Pillar.

THE accompanying plan has been designed specially for elementary students, to enable them to understand the bord and pillar method of winning coal. The manner of procedure is as follows:—Roadways or levels of between 2 to 5 yards in width are cut through the coal from the pit. At certain distances, depending upon the depth of the seam from the surface, other roadways or bords are driven at right angles to the main headings, thus connecting them one to another for ventilating and conveying purposes. In this manner the whole estate to be worked is cut into rectangular blocks of about 30 yards square. The removing of the pillars is usually



(Plan shewing Bord and Pillar method of Working Coal).

performed by taking strips of about six yards in width from the pillar until the whole of it is removed. The pillars are brought back from the boundary, the farthest being taken first, so that when they are removed the roof may be allowed to fall, as access to that portion of the mine will then be unnecessary. It is not practicable, from reasons just stated, to remove the pillars immediately they are cut, in such near proximity to the other workings, and if they are left for any considerable length of time, the weight of the superincumbent strata crushes the coal fine, and its value is materially decreased thereby. So it would seem that the best plan is to work the mine in such a manner that the pillars may be removed soon after being cut, without harm or hindrance to the rest of the mine. The white lines in the diagram are intended to show the roadways, and the black the solid coal. That portion marked "Goaf" shows where the pillars have been removed. On the left hand side of the figure the manner in which the roadways are cut to meet each other is shown. The reader will no doubt have noticed that the pillar near the shafts is considerably larger than the others, the reason for this is to protect the shafts, for if the coal was removed from near the pits they would subside, and perhaps close up. The size which this pillar ought to be will be discussed in another chapter.

A Russian mathematican, named Nicholas Copernicus, was the first who really put forward the idea of the world revolving, and he wrote a book in Latin on his views in the beginning of the 16th century. The Italian philosopher, Galleo, about this time completed his invention of the telescope; and with its aid proved the correctness of Copernicus' theory of motion.

WINDING.

THE subject of winding engines is that which is most intimately connected with the successful working of a colliery, because the amount of the coal-get and the safety of all the men employed underground depends directly upon the efficiency and control of the winding engines. The one great particular in which these engines differ from nearly all others is that as the winding never perhaps exceeds one minute in duration, the engines have to be got up to full speed and slowed down to nothing in a very few seconds of time, and this fact requires that the engines shall be very powerful, and shall also be capable of being regulated to the greatest nicety. The most satisfactory method is to have a pair of horizontal direct-acting engines, working at a pressure of from 60lbs. (in the majority of cases) to about 100lbs. (the exceptional instances). The winding ropes are coiled on to a large drum, and are so arranged that as one winds off the other winds on to the drum, that is, one winds over it and the other under. Considering the speed at which the engines have to run, it can easily be seen that any brake which may be used, to be effective, will have to be of great strength. There are two sorts of brakes now in use, namely, the foot brake and the steam brake. The foot brake acts on the run of the wheel and may be applied gradually, but the steam brake exerts all its power direct and at once, and should only be applied in cases of emergency, as it is so powerful that were men to be in the cage at the time of stoppage, the probability is that they would be thrown out. A rule for finding the weight, a pair of engines of given dimensions, &c., are capable of starting, is the following :—Take the following details of the engines: 20in. cylinders, 44 inch stroke, steam pressure, 60lbs.; and the winding drum, 16 feet diameter. The area of the cylinder will be $10^2 \times 3{\cdot}1416 = 314$ sq. in. Multiply this by the pressure of steam and by twice the length of the stroke, $314 \times 60 \times 44 \times 2 = 1{,}657{,}920$. Divide this result by the circumference of the drum $= 16 \times 12 \times 3{\cdot}1416$ inches, and the answer will be the theoretical power of the engines $= 1{,}657{,}920 \div 603 =$ nearly 2,750lbs. Deduct $\frac{1}{3}$ for friction, leaving about 1,833lbs. as the load the engines can start. This example assumes that the cages balance each other and also the tubs.

SOUTH STAFFORDSHIRE COALFIELD.

THE area of this field is about 140 square miles, having a length of about 20 miles in a north and south direction, and an average breadth of 7 miles. It lies between two great faults ranging north and south, and these have been the means of raising the coal in this area to a workable limit. Beyond the faults the Permian and Triassic rocks set in. It was thought that the coal would extend under the Permian rocks, and shafts were put down to pierce the strata. At Wassel Grove the trial was unsuccessful; but further east near Birmingham, a shaft was sunk through the Permian beds, and the thick coal was proved at a depth of 418 yards. The field contains six workable seams of coal the order, and thickness of which, as given by Mr. Jukes, is as follows :—

Trias Formation ....1,200′
Permian Formation...1,000 to 3,000′

Carboniferous Formation:—

COAL MEASURES (SOUTHERN DISTRICT.)

Red and mottled clays, red and grey sandstone, and gravel beds ...	800′
(1) *Brooch Coal*	4′
Strata with ironstone	130′
(2) *Thick Coal*	30′
Strata with gubbin ironstone	20′
(3) *Heathen Coal*	4′
Strata with ironstone	109′
(4) *New Mine Coal*	8′
Strata with ironstone	16′
(5) *Fire-clay Coal*	7′
Strata	30′
(6) *Bottom Coal*	12′
Strata with several courses of ironstone	140′

The 10 yard or thick coal seam is the most valuable and is found at a depth of about 140 yards from the surface; this seam being at a moderate depth has been worked extensively, and the difficulty of working it, has caused a very great part of this fine seam to be destroyed. It is estimated that little more than 10 % remains to be worked. In the northern part of the field the thick coal becomes split up into nine district seams, with a combined thickness of about 10 yards, but separated by 140 yards of strata, which is absent to the south. The quantity of coal remaining to get is about 900 millions of tons.

GRAVITY.—*Continued.*

AS it has already been intimated this accelerating force is equal to 16·1′ per second, and to find the distance travelled over in any particular second, all we have to do is to double the number of seconds the body has travelled, subtract one and multiply by 16·1; take the last question as an example—If a stone has been falling freely through space for five seconds, how far will it have travelled during the last second? $(5\times 2)-1 \times 16{\cdot}1 = 144{\cdot}9'$. Thus we can prove whether the last question is correct or not:—

$$\left.\begin{array}{lll} 1 \text{ second} & = (1\times 2)-1\times 16{\cdot}1 = 16{\cdot}1' \\ 2 \quad ,, & = (2\times 2)-1\times 16{\cdot}1 = 48{\cdot}3' \\ 3 \quad ,, & = (3\times 2)-1\times 16{\cdot}1 = 80{\cdot}5' \\ 4 \quad ,, & = (4\times 2)-1\times 16{\cdot}1 = 112{\cdot}7' \\ 5 \quad ,, & = (5\times 2)-1\times 16{\cdot}1 = 144{\cdot}9' \end{array}\right\} = 402{\cdot}5'$$

In working out the above problems I have chosen the simplest formula I know, and that the mind of the uninitiated might not be confused, I have chosen bodies falling in a straight line unimpeded by any resistance whatever. Gravitation must be recognised in dealing with certain engineering problems, for instance—a fly-wheel of a steam engine is not cast by guess, but that it might store a certain amount of work or energy, and gravity must be considered when calculating the energy which it is desired the fly-wheel shall store up, this will be made more clear by an example—The radius of a fly-wheel is 9′ and the rim of the wheel weighs 12 tons. What should be the velocity of the rim of the wheel to store up 24 tons of energy? Here we have given the weight, diameter and amount of energy it is desired shall be stored up in the fly-wheel. In this problem let $G=32{\cdot}2$, E=energy, M=mass, V=velocity. Now the velocity will be found from the following formula $V=\sqrt{\frac{E\times 2G}{M}}$ Therefore substituting figures we get $V=\sqrt{\frac{53,760\times 2\times 32{\cdot}2}{26,880}}$ $=11{\cdot}34$ per second. Again when the velocity and energy are given, the weight of the rim may be found from the following formula—$M=\frac{E\times 2G}{V^2}$ and once more substituting figures we may find the weight of the rim of the fly-wheel in the last example, thus—$\frac{53760\times 2\times 32{\cdot}2}{(11{\cdot}34)^2}=$ 26880lbs. or 12 tons. If gravity be

the cause of weight, it is evident that gravity is the force which engines have to overcome, that is apart from friction. Then from an economical point of view, when possible, the roads in a mine should be driven in such a direction that the greatest maximum effect from gravity may be obtained; this effect is found—experiments tell us—in a horse road, when the inclination is $\frac{1}{130}$ or ·2769′ per yard. This will give a theoretical velocity of 4·21852′ per second, thus—$\sqrt{\cdot 2769} \times 8\cdot 02 = 4\cdot 21852$. But water and tubs would not flow with this velocity in a road rising 1 in 130, in consequence of friction and other obstructions. In calculating the work done by self-acting inclines, hauling engines, &c., gravitation must be taken into consideration, for instance, a road along which a load of 15 tons is being drawn, rises 1 in 10. What are the foot pounds due to gravity? The foot pounds due to gravity are $\frac{15 \times 2240 \times 1}{10} = 3360$. These are sometimes stated as the foot pounds due to inclination, which is certainly more comprehensive but hardly as appropriate. Gravity is an important subject and should engage the attention of every Student of Mining, because its laws are so inseparably connected with the scientific part of his studies. A study of the subject in some advanced work cannot be too strongly recommended.

PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final.

A competitor may answer any number of questions subject to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by July the 6th, 1893.

Question 1—Two roadways commencing at the same place are being driven by lines; the angle enclosed between the lines is 30 degrees; one road is 50 yards and the other 130. What distance are the ends of the roads apart, and what area of coal do they encompass?

Question 2—Proto-carburetted hydrogen gas. What percentage of this gas is required to be mixed with air to enable you to detect its presence? What is the weight of the gas compared with atmospheric air?

Question 3—State your experience with the barometer and thermometer in connection with mining. Supposing you have a mine 150 yards in depth, and another 250 yards in depth; what will the difference in the reading of the two depths be? What is a thermometer, and how is the ventilation of a mine affected by the changes of this instrument?

Question 4—How do you measure the air in a mine, and what speed should it travel through the workings?

Question 5—Describe the principle and construction of a man engine with sketch.

Question 6—Name the three great divisions of the carboniferous formations, and explain under what conditions the useful minerals are found that are contained in them.

Question 7—What precautions would you take when ripping or taking down top caunch for the erection of a crossing in a dry and dusty mine?

Question 8—Describe with sketch the operations of getting coal in a seam of the following section—roof good, top coal 1¾′, dirt parting 1′, bottom coal 3′.

Question 9—What are the leading groups or formations of stratified rocks? Describe the chief mineral contents of each.

SELECTION PRIZE.

This is a prize which every reader can compete for, as it requires little trouble. Write on a slip of paper what you consider to be the two most popular articles of this paper (Answers to Questions excepted), and underneath write your full name and address. "Mining" will be sent post free for six months to the sender of the envelope first opened containing the names which receive the greatest number of votes. No envelopes will be opened before Monday morning, the 3rd July, and the result of this prize will be published, if possible, in next issue. All envelopes must be marked "SELECTION."

The great scientist, Tyndall, tells us that by the simple stoppage of our planet in its orbit, the elements might be caused to melt with fervent heat. The amount of heat thus developed would be equal to that derived from the combustion of fourteen globes of coal, each equal to the earth in magnitude. And if, after the stoppage of its orbital motion, the earth should fall into the sun, as it assuredly would, the amount of heat generated would be equal to that developed by the combustion of 5,600 worlds of solid *carbon.*

ANSWERS TO QUESTIONS
In No. 14.

Question 1—What are bituminous, free-burning and smokeless coals? Give an example of each.

Answer to Question 1—

Bituminous coal is of two varities, viz: coking and non-coking. It is very valuable for the purpose of making steam, and also for household purposes, it soils the fingers when handled and breaks with a cuboidal fracture and is usually of a dull colour. Its specific gravity is 1·26 and is composed of 83 per cent. carbon, 6 per cent. oxygen, 5 per cent. hydrogen, 2 per cent. nitrogen, and 4 per cent. ash. Bituminous coal varies from 2 to 9′ thick in Yorkshire. Free burning or cannel coal is of a very dull lustre and breaks with a conchoidal fracture, it burns with a bright flame and is used in the manufacture of gas for illuminating purposes, it is composed of 78 per cent. carbon, 10 per cent. oxygen, 7 per cent. hydrogen, 2 per cent. nitrogen, and 3 per cent ash. It is a very hard and compact coal of a black or brownish colour, and is sometimes glossy but more frequently dull in lustre. The word cannel is divided from candle because it burns with a bright flame like a candle. It is sometimes called rattlers in Yorkshire on account of the rattling sound emitted from it. The smokeless or anthracite is a hard non-flaming coal and breaks with a conchoidal fracture. This coal is not much known in this country on account of it not having been worked extensively, it is therefore very little used, and is not so valuable as the coals before mentioned. Anthracite coal is foun[d] in South Wales, Ireland and Pen[n]sylvania (U.S.A.,) it has a spec[ific] gravity of 1·4, and is made u[p]

y be

carbon 92 per cent., hydrogen 2·5 per cent., nitrogen ·8 per cent., oxygen 1·2 per cent., and ash 3·5 per cent. It is not suitable for burning in open grates, as it requires a long time to ignite.

BENJAMIN NIGHTINGALE,
Ryhill, Wakefield.

Question 2—Describe a method of long-wall working on a thin seam with a good roof.

Answer to Question 2—

The term "Thin Seam" is rather a vague expression. A seam 5 or 6′ thick would be considered thick in certain localities, while in others it would be considered thin. For present purposes I will assume the seam to be 3′ thick. The under-cutting or "bearing" should be done in the underclay, and should be about 15″ thick, and this would provide debris to stack the waste.

The roof along the face should be supported with chocks and props as shown in sketch, to be set every 6′ in the direction the face is advancing, and from 9 to 12′ along the face. Two feet of the rock forming the roof must be taken down in the drawing roads (to give the necessary height), and built into packs along the road side. Drawing roads are left at right angles to the face as shown in sketch, one being slightly in advance of the other to a loose end for the next collier's place. The working face should be parallel to the cleat of the coal.

The gateways are set about 20 yards apart, and cross-gates are commenced every 70 or 80 yards from the mother gate, as circumstances allow so as to cut off the lower gateways. The dotted lines in sketch show the old gateways cut off by the new cross-gates. The tubs should be run to the mother or centre gateway by the putters, or if the cross-gates are of considerable length by horses or ponies. The centre gateway should be worked by a self-acting jig if the gradient were sufficient, if not, then by some other method consistent with the amount of coal won in each district and the inclination of the haulage road.

ISAAC SMITH,
18, Hardwick Place,
Hunslett Carr,
Leeds.

Question 3—What gases are met with underground, and to what extent are they dangerous in the air of mines?

Answer to Question 3—

(1) ATMOSPHERIC AIR consists of two principal gases, viz.:—Oxygen and nitrogen; the nitrogen is much

the more abundant of the two, being to the oxygen as four is to one; it is colourless, tasteless and inodorous, and its specific gravity may be taken as 1, besides O and N atmospheric air contains CO_2 and a variable quantity of watery vapour. It is unnecessary to state that this gas is not dangerous, that it is in fact the very supporter of life. (2) CARBONIC ACID GAS (CO_2) Composition O 72·73 + C 23·27 = 100. Is known also by the terms—stythe, choke damp or black damp, its specific gravity as compared with air is 1·524; it is the heaviest gas found in mining, hence it is always found next to the floor. It has a slightly acid taste, and causes a naked light to burn with a dull and heavy flame, but if the percentage of this gas be increased lights are extinguished; its danger arises in the fact that it will not support life, as 3 to 4 % is unfit to breathe, 5 to 6 % is dangerous, and from 8 to 10 % is fatal. (3) CARBONIC OXIDE GAS (CO) White-damp. This gas is lighter than air, and is found next to the roof, has a specific gravity of ·975. It does not support combustion, but lights burn with a blue flame in it; is tasteless but has a peculiar odour. Is dangerous, because it does not support life; it acts as a deadly poison. 1 % of this gas is speedily fatal to life, and ½ % if breathed for long, produces the same result. O 56·69 % C 43·31 % by weight, it is produced by the explosion of blasting powders. (4) SULPHURETTED HYDROGEN (H_2S) specific gravity 1·174, composition, sulphur, 94·15 %; hydrogen 5·85 % by weight; it is a colourless gas, but has a strong smell not unlike that of rotten eggs; is dangerous in that, it does not support life and combustion, but is itself inflammable. Breathed *in an undi*luted state it is fatal to *life, and when diluted* with ten times its volume of air it produces sickness, giddiness, weakness, and loss o sensation. A candle will burn in a mixture where life cannot exist, it is produced by the decomposition of animal and vegetable matter and by the blasting of powder. (5) CARBURETTED HYDROGEN (CH_4) Firedamp. Specific gravity ·555. Composition—Carbon 75·4%, Hydrogen 24·6 % by weight; has neither colour, taste or smell, and with its low specific gravity accumulates next to the roof. When about 3½% of this gas is present in the atmosphere it may be detected by a blue cap appearing on the flame of a lamp or candle. Is dangerous in that it is an explosive gas; when the gas is pure lights are extinguished, and it becomes explosive when mixed with certain proportions of air. Mixed with 3·5 times its volume of air it does not explode but burns quietly, and with 9½ volumes of air the explosion is the greatest; will soon cause death if breathed in an undiluted state. This gas is a natural product given off by the coal seams. (6) AFTER-DAMP.—This gas is found in mines after an explosion of fire-damp, and is a mixture of that gas with air; it is dangerous in the fact that it will not support life, and many persons who have escaped an explosion fall victims to this deadly gas. Several other gases are also found in mines, but to such a small extent that they do not become dangerous and are easily dealt with.

THOMAS BEST,
Railway Street, Tow Law,
Co. Durham.

Question 4—How would you prove a coalfield by boring for the purpose of fixing the position of a new sinking?

Answer to Question 4—

I should put not less than four boreholes down to prove the coalfield, when I would obtain the following information, viz.:—The depth of the seams, the number of the seams, quality of the seams, thickness and inclination of the seams, the nature of the roof and floor, the great interruptions or faults passing through the coalfield, whether bands exist in the seams or not. I should also require the master borer to keep a correct section of the strata passed through. If faults or whin-dykes traverse the coalfield the shaft must be sunk in the best possible position, and the mine laid out to require the least possible amount of dead work or tunnelling, having regard to relieve as far as possible the haulage and drainage. The centre of a royalty is usually chosen as the best position for a shaft, but if the centre contains a large number of faults some other place must be selected. From the above particulars we will be able to decide upon the best and most productive system of working the seam or seams; the inclination will decide the direction and course of the main roads, of which there should be three or four, and the adoption of the best system of haulage and drainage. Haulage should be laid out so that advantage is taken of the gradient, for the easiest, best, and most economical mode of transit for the coals. The kind of borer I should use would depend on the depth and nature of the strata. For ordinary strata, I should use the common percussive boring tools to a depth of 150 or 200 yards, afterwards I should employ the Mather and Platt process, or if the strata were hard the diamond borer.

THOMAS BEST,
Railway Street, Tow Law,
Co. Durham.

Question 5—Describe some methods of using iron or steel instead of timber in shafts and levels.

Answer to Question 5—

At many collieries iron and steel are rapidly supplanting the place of timber. Instead of wooden guides for the cages, we have in many places either rigid iron conductors or wire rope conductors; cast-iron boxes are also used by building them in the brickwork for the insertion of the horse-trees, instead of leaving holes in the brickwork. Metal tubbing is also used instead of timber or brickwork for the sides of the shaft. To support the roof of the levels we also use steel and iron instead of timber, old railway metals are sometimes utilised for this purpose, we also use metal sleepers on which to lay the rails instead of timber; these are cast with slots in them the required gauge, also the waggons are in many places made of sheet-iron.

SAMUEL HOPE,
Mosley Common, Boothstown,
Nr. Manchester.

Question 6—Describe in detail some form of underground pumping engine.

Answer to Question 6—

For permanent works where large quantities of water have to be continuously raised, the Cornish pumping engine with the Cornish tubular boiler, has proved itself superior to all others. The Cornish pumping engines are generally single-acting beam engines. To regulate the supply of steam in the cylinder, three slides are used, viz.:—steam or expansion, exhaust or eduction, and the equilibrium slide; the cylinder is always provided with a jacket; the steam valve admits the steam to the

top of the piston, and after forcing it down, part of the stroke is done expansively. By means of the equilibrium valve, the same steam is allowed to pass to the bottom of the piston and assist in the return stroke, after which it escapes to the condenser through the exhaust valve. The greatest advantage is taken of the expansive properties of steam, as it is "cut off" at an early part of the stroke. The beam is generally an unequal one, and is supported on two cast-iron columns or on walls of solid masonry. By the use of an unequal beam the piston gives a longer stroke without increasing the velocity at which the pump plunger works, thus preventing the wear and tear of the latter. The chief features of this class of engine, are:—The large employment of the principle of expansion, causing great economy in the use of fuel, the cataract which ensures a slow stroke by regulating the supply of condensing water; the mode in which the valves are worked, the employment of steam for the down stroke, the upstroke being caused by the weight of the rods, &c., at the other end of the beam. The eduction valve allows the steam to escape to the condenser when the down stroke is to be made, and it is opened a little before the steam or expansion valve, so that the steam may have a longer time for condensation.

THOMAS BEST,
Railway Street, Tow Law,
Co. Durham.

The Chaldeans made a rough guess of the earth's magnitude, by saying it would take a man a whole year to walk round. If it were possible to do so, they would not have *been very* far out with their guess.

NOTICES.

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Cowie.—We are in daily receipt of letters such as yours, giving praise to our journal. It is our intention to merit still more praise for our future issues. We are of the same opinion as you regarding the lines upon which to conduct this paper, as will be seen from this issue. Subscription duly received, shall send on journal for prescribed period.

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MINING

A Journal devoted to the interests of Mining.

No. 17. Vol. I. JULY 13, 1893. FORTNIGHTLY ONE PENNY.

GENERAL INFORMATION.

AN ANCIENT COAL WAGON.—Messrs. Hough & Son, Heath End Colliery, Pelsall, have presented the South Staffordshire and East Worcestershire Institute of Mining Engineers with a coal wagon recently recovered from some old workings in their collieries, which is supposed to be from 200 to 300 years old. The relic is an interesting one, and will doubtless prove a valuable acquisition to the museum of the institute.

* * *

A sensitive paint has been invented which should prove useful for detecting hot bearings in machinery. It is always a bright yellow when cold, but gradually changes colour on being heated, and at 220° becomes a bright red.

* * *

If all the power that coal possesses could be converted into mechanical work, one pound would be sufficient to perform work equal to four horse-power for an hour. But steam engines generally use four times this amount.

* * *

It is estimated that a man working on a treadmill raises himself to a total of 10,000 feet high. If his weight be taken as 150lbs. this will give the work performed in a day as $150 \times 10{,}000 = 1{,}500{,}000$ foot pounds, or taking the length of the day as eight hours 3,125 foot pounds per minute.

* * *

It is proposed to construct a tunnel below the bed of the Neva, at St. Petersburg. It will be circular in section, 43 feet in diameter, and 410 feet long. Throughout its length it will be divided into four stories. In the first all the telegraphic and telephonic cables will be laid; the second will be reserved for pedestrians; through the third, which is the largest of the four, carriages, wagons, and other vehicles will have a right of way; and in the fourth itself will run tramcars. The cost of the construction of the tunnel has been estimated at about £400,000.

One of the deepest boreholes in the world is that of Spurenberg, near Berlin, put down for rock salt. It was 16 inches in diameter at the commencement; when about 1,000 feet deep it was reduced to 13 inches, going to a depth of 4,194 feet (over three-quarters of a mile). The deposit of salt is not completely passed through, although the borehole found it at a depth of 3,907 feet.

* * *

BROT found that he could hold a conversation, in a low voice, through the empty water pipes in Paris, 3,120 feet in length; and that a pistol fired at one end extinguished a lighted candle at the other.

* * *

COAL MINING IN AMERICA.—Mr. Emerson Bainbridge, who has just returned from America, states that, in regard to coal mining, the conclusion he has come to from information and observation is that the American mining industry is very much as the English coal industry was thirty or forty years ago. That is to say, Americans are able to do a large quantity of mining at shallow depths or in the hill sides, working seams of considerable thickness, and they are able to bring to bear upon this kind of mining, which has almost ceased to exist in England, all the experience and appliances of the last thirty years. The result is that a number of mines are producing coal at a cost, including everything, of about 3s. 6d. per ton, which is far below the average of the best English collieries. Mr. Bainbridge thinks it is at present premature to refer to the general conclusions he arrived at with regard to the development of mining machinery, but, generally speaking, he came back satisfied with the comparison he was able to draw between England and the United States. Unless the present high cost of producing coal in England is brought down, Mr. Bainbridge has litttle doubt that America will gradually develop the exportation of machinery to foreign countries, and that correspondingly England, which has long held the foremost place in this respect will fall away.

SURVEYING.

THE illustrations show two Improved Hedley Dials manufactured by **J. DAVIS and SONS, Derby.** Fig. 1 shows the dial in position for taking dip; this is done by means of the detachable arc on the side of the instrument. The method of procedure is as follows:—The dial is first truly levelled by means of the spirit levels fixed at right angles to each other on the face of the compass; next the clamp (shown at the N end of the dial) is turned so as to allow the outer framework to revolve on its axis. In fig. 2 two clamps are attached for this purpose, one at each end of the instrument. Now, it will be seen by close attention to the illustration (fig. 1) that at the top of the lower sight is a small hole about the size of a pin's head, and at the top of the other sight is a somewhat larger hole fitted with cross-hairs. Now to adjust the instrument place the eye at the smallest hole and fix the sights so that the point where the hairs cross each other will be exactly in line with the eye and the light held at the point to where the dip is required. The amount of dip is ascertained by reference to the arm fastened to the axis of the instrument which moves along the arc. The number of degrees is then read off from the point of the index. In this case 35 degrees.

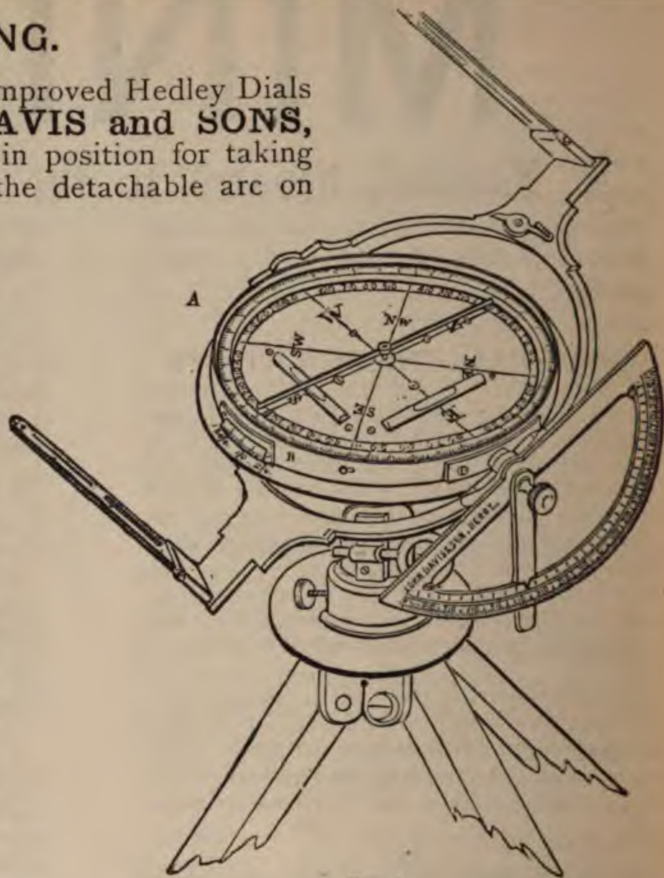


Fig. 1.

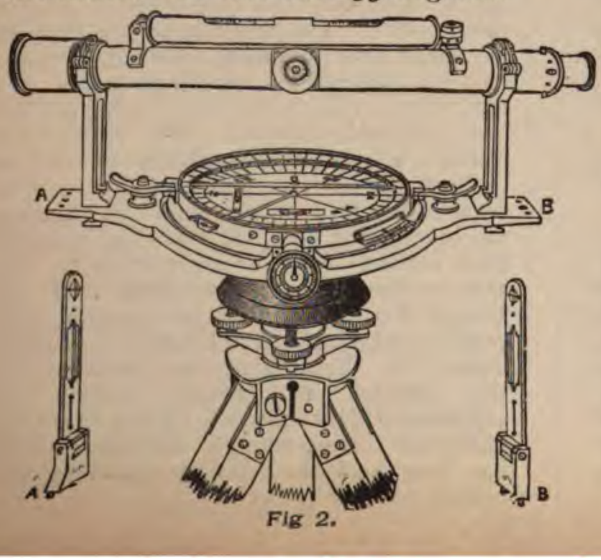


Fig 2.

Fig. 2 represents the same instrument with several improvements for more accurate work. We here give a description of it as furnished by the makers. The dial combines all the latest improvements of the Hedley with the outside vernier of the theodolite. It consists of a compass box 5 or 6″ in diameter, divided into 360 degrees on the compass ring, and into four times 90 degrees on the plate, O° being at the north and south points, and 90° at the west and east points. There are two spirit levels at right angles to each other on the face of

the instrument, protected by the glass cover of the compass box; the sights are similar to the other forms of Hedley dials. Underneath the main plate, there is a circle or limb divided into 360 degrees. A vernier attached to the outside of the compass box enables horizontal angles to be read with great precision; being placed on the outside of the circumference of the dial, the vernier is more easily read than when placed inside the compass box, and the necessity of raising the head above the dial face is obviated. The upper and lower limbs of the instrument may be fixed together at 360 degrees if required by means of a pin under the body of the instrument. The Hedley form of side arc for taking vertical angles is replaced by a fixed circular box $1\frac{3}{4}''$ in diameter with a hand traversing a dial plate divided into four divisions of 90 degrees; this new form of arc presents the advantages of always being in position, and of being so compact that it does not interfere with the manipulation of the screws under the body of the dial. For surface surveying, a telescope may be substituted for the sights. The special features of this dial is the arrangements by which bearings may be taken simultaneously with the magnetic needle, and with the vernier, *the latter automatically checking the former*; thus, any error arising from incorrect reading is at once detected. The graduations of the vernier ring and the needle ring are so arranged that the readings correspond; this is effected by numbering the dial from the north from left to right, and by numbering the vernier ring also from left to right.

As may be seen by illustration the ball and socket joint is replaced by a much more accurate arrangement known as the Hoffman joint; it is claimed to possess the following advantages over the ball and socket joint.—(1) The plumb line is suspended from the actual centre of the dial. (2) The rubbing surface is some ten times greater, and consequently the joint is rigid. (3) The joint is manipulated with greater ease and rapidity. A slight turn liberates the two concentric hemispheres; the dial is then levelled up, and a slight turn of the flange from left to right secures the joint. (4) Only one hand is required to manipulate the joint. (5) The total height of the joint is $3''$, that of the ball and socket joint $3\frac{5}{8}''$; the length of the centre is $2\frac{1}{8}''$, that of the ball and socket is barely $1\frac{1}{2}''$. The Hoffman joint is not heavier than the ball and socket joint.

A description of this joint is not necessary in a journal of this class.

GEOLOGY.

Fossils.

THERE are two general ways in which fossils of plants or animals may be formed. Firstly, by being entirely surrounded by material, and then washed away, leaving an impression on the gradually hardening substance surrounding them; and secondly, by being washed away and their place taken by some hard rock, which assumes exactly the shape and size of the original object. The word "fossil," as it is used, means either the original object, or any impression, or trace left by it. Fossils are perhaps the most important means we have of determining the age of the different strata in which they are found. For by seeing whether the fossils of one series represent plants or organisms of a

more or less advanced species than those of another formation, and by comparing their differences we can arrive at the conclusion as to which series was deposited first, and it will also give us some idea of the length of time which elapsed between the two depositions. Fossils are thus of the highest value in tracing out the modifications and improvements which took place in the various organisms, and show the various stages of their perfecting growth and also of their decay and dying out. Animals, on the whole, leave far more lasting impressions than plants, especially those which possessed very hard and shell-like coverings, and this also explains why the leaves of the various plant organisms are found in proportion to the large number of roots and branches, these latter being so much harder. Also, it is a fact that the bottom of the sea possesses far greater advantages for the preservation of organic remains than the land surface does, for at the bottom of the sea, out of reach of the influence of the waves, there is comparative calm, and any deposits are speedily covered up and preserved as testimony of that time for future ages. Lakes surrounded by luxuriant vegetation are perhaps even more favourable for fossils than the sea, and it is in old lake beds that the finest remains of fish are to be found. Fossils are also useful in indicating whether there has been any great change in the climate of the country. For instance, if the fossils of palm trees, tigers, elephants, and other tropical animals and plants were found in strata discovered in a country undergoing an arctic condition of climate, the certain inference would be that there had been a *great difference* taking place in the temperature and other climatic conditions, and on the other hand, if the bones and remains of the reindeer, the willow-tree, etc., were found it would be evidence of a change in the climate from hot to cold. Also, if fossils of shells, sea-anemones, and other organisms, such as exist only in sea water, were discovered far away inland, we should say that the sea had certainly extended so far inland at one period of the earth's history. Several sets of formations are divided into zones or horizons and classified together, according as one characteristic fossil has flourished through the one formation. For instance, the fossil Trilobite gives its name to the formations from the Cambrian, up through the Silurian and Old Red Sandstone, on to the Carboniferous formation.

EXPLOSIVES.

Chapter I.

The numerous explosives now in use in mines is sufficient to show the remarkable progress made in this department of mining—if we look back a few years to the period when gunpowder was the only one employed. Each of the many explosives have some characteristic advantage claimed for it, which fits it for some special work. We may take two explosives, one of which exerts a powerful action upon a small area, the other a weaker but more prolonged action upon a larger area. The first will exert a shattering force, the other a rending action. So we see that the choice of an explosive depends upon the nature of the work required to be done by it. For hard rocks the first, or powerful one, has the preference, and for soft material the milder

explosive. Not only are these points to be considered when choosing an explosive, but important questions like the following require attention: "The price of explosive." "Quantity required to perform a definite amount of work." If a large quantity of the explosive be necessary, a larger hole will have to be made, and, consequently, more labour expended than would otherwise occur. "The ease and rapidity with which the shot can be charged." "The relative dangers appertaining to each explosive, &c." I will now describe several explosives, giving the nature and composition of each:—

Gunpowder.—The use of gunpowder for blasting in England is only about two-and-a-half centuries old. It was known to the Chinese long before the 12th century, this being the first period of its being known in Europe of which there is any note. It was first used for blasting in Germany about 1620, and was shortly afterwards introduced into the copper mines in Staffordshire by two German Miners. It is composed of salt petre, charcoal, and sulphur, and its usual form is a bobbin. It is readily affected by moisture, hence the difficulty of employing it in wet ground. Several precautions are used to remedy this defect with some success. The gas evolved by the explosion is from 4,000 to 6,000 times the volume of the powder. It possesses one great advantage in so much as it safe for handling and transportation, but it is not nearly so powerful as the modern explosives.

Nitro-Glycerine is formed through the action of concentrated nitric acid on glycerine. Its specific gravity is 1·6. The following equation represents the process of the combination:

$$\overbrace{C_3H_5(OH)_3}^{\text{Glycerine.}} + \overbrace{3NHO_3}^{\text{Nitric Acid.}} = \overbrace{C_3H_5(O.NO_2)_3}^{\text{Nitro Glycerine.}} + \overbrace{3H_2O}^{\text{Water.}}$$

At ordinary temperatures it is an oily liquid, clean, colourless or yellowish, of sweetish and burning taste, without odour. At about —15°C it becomes solid. Its explosive power compared with gunpowder is by volume 13 to 1, and the gases given off by the explosion are very many times larger than would be given off from an equal quantity of gunpowder, and are evolved at a far greater heat. A light applied to it will kindle it to a flame, but not explode it. The moment the light is removed the flame of the nitro glycerine dies out. The temperature must reach 257° before it will explode, and it is even then necessary that it be in a close space. The detonation of gunpowder, guncotton, or fulminate, will cause it to explode, and this is the usual method of using it. It is very powerful in its effects, 5lbs. placed in a hole 10 feet deep has loosened 350 tons of rock and rent huge fissures in the remaining rock for several yards in the vicinity. If it is taken into the human system it causes serious results and produces stupor, weakness of sight, and pains. Ten grains taken inwardly is sufficient to cause death. Even mere contact with the skin will produce serious symptons. This explosive has been solidified by means of guncotton collodion, and has received the name of nitro-gelatine. In this form it is now principally used, as it possesses many advantages over nitro-glycerine. It is much safer, better to handle, and is quite as powerful. It is exploded by detonating with fulminate, and may be used in water. Sometimes it is mixed with camphor to minimise the risk of exploding while handling or with shocks or heavy blows.

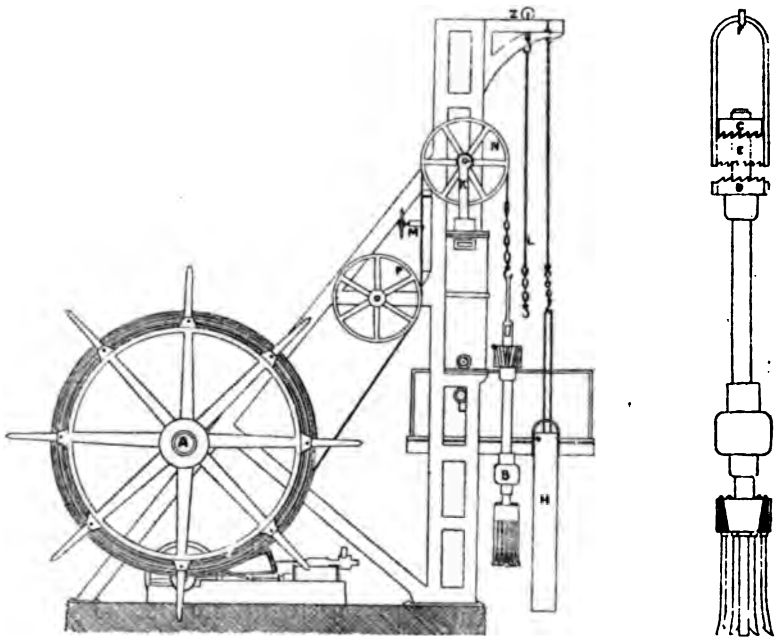
Mercury boils at 350°C., and freezes at—40°C

BORING.

Mather and Platt's Method.

THE following description of this method of boring is that given by Mr. Mather himself.

In the boring tool and the method of giving the percussive action, as also in the shell pump, especial novelty will be found. Instead of these being attached to rods, as in the old system employed in this country, they are suspended in turn from a flat rope about ½in. thick and 4½in. broad, and the boring tool and pump are let down and drawn up as quickly as the buckets and cages in a coal pit. The rope is wound upon a large drum (A) by a steam engine with a reversing motion, by which one man can regulate the operation with the greatest nicety and ease. The boring tool or boring head (B) consists of a wrought-iron bar, about 4in. diameter and 8ft. long, at one end of which a cast-iron *block is* secured. This block has numerous square holes through it, into which the cutters are inserted in such a way as to be firm in working, but still readily taken out for repairing and sharpening. Higher up the bar, a little above the block, is another casting, which simply acts as a guide to keep the bar perpendicular. Higher still there is another such casting, but on the circumference of this are secured cast-iron plates, with the ribs of a saw tooth shape arranged at such an angle that as they bear against the sides of the hole, when the bar is raised or lowered, they assist to turn it so that the tool strikes a different portion of the rock at each stroke. Immediately above this is an arrangement by which certain rotation is secured. To effect this two cast-iron collars (C, D, enlarged sketch) are cottered fast to the bar, about 12 inches apart. On the top edge of one and lower edge of the other collar deep saw teeth are cut about two inches pitch. The collars are so placed that the perpendicular


Sketch of MATHER & PLATT'S Boring Machine.

side of a tooth on the lower one is under the centre of the inclined side of a tooth in the upper one—that is to say, one is placed half-a-tooth in advance of the other. Between these collars and sliding on a bar is a deep bush (E), on the lower and upper edges of which are teeth exactly corresponding with, and fitting into, the teeth in the lower and upper collars. To this bush is attached the wrought-iron bow (F), by which the whole bar is suspended by means of a hook and shackle at the end of the flat rope.

The rotary motion of the bar is obtained as follows:—When the bar strikes the rock the rope is allowed to be a little slack, this causes the bush, to which the bow is attached, to slide an inch or two down the bar, until it is liberated from the teeth of the top collar (C) or ratchet, and fits itself into the teeth of the bottom one. But as the teeth of the latter are half-a-tooth out of direct line with the other, the bush must twist slightly on the bar before the teeth on the underside of it fit completely into the lower collar or ratchet. This slight turn of the bush, which may be varied by making the ratchets of a coarser or finer pitch, gives a twist to the flat rope, which is increased as the tension is put on, for the bush strikes the teeth of the upper ratchet, where the same action must take place as in the case of the lower one. The result of these motions is, that when the whole weight of the bar is taken by the rope, the latter being flat, will naturally assume its straight position, and in untwisting takes the bar round with it. This simple but most effective action takes place at every blow made by the tool, and so a constant change in the position of the cutters goes on, and their effect in breaking the rock is necessarily increased.

The shell pump (H) is a cylinder of cast-iron, about eight feet long, a little less in diameter than the size of the hole. At the bottom is a clack opening upwards, somewhat similar to that in ordinary pumps. Above this clack there is a bucket, similar to that of a common lift pump, with an Indiarubber clack on the top side.

The percussive motion is produced by means of a steam cylinder, which is fitted with a piston of 15 inches diameter, having a rod of cast-iron, seven inches square, branching off to a fork (K), in which there is a pulley (N) of about three feet in diameter, of sufficient breadth for the rope to pass over, and with flanges to keep it in its place.

As the boring head and piston will both fall by their own weight when the steam is shut off and the exhaust valve opened, the steam is admitted only at the bottom of the cylinder. The exhaust port is a few inches higher than the steam port, so that there is always an elastic cushion of steam of that thickness for the piston to fall upon.

The general arrangement of the machine may be described as follows: The winding drum (A) is 10 feet in diameter, and is capable of holding 3,000 feet of rope; from the drum the rope passes under a guide pulley (P), through a clam (M), and over the pulley (N), which is supported on the forked end of the piston rod (K), and so to the end which receives the boring head (B), which being hooked on and lowered to the bottom, the rope is gripped by the clam (M). A small jet of steam is then turned on, causing the piston to rise slowly until the arm moves

the cam which opens the steam valve and gives the full charge of the steam. An accelerated motion is then given to the piston, raising the boring head the height required, when the steam is shut off and the exhaust opened, thus effecting one stroke of the boring head as regulated by a back pressure valve on the exhaust pipe. The exhaust port being six inches from the bottom of the cylinder, when the piston descends, it rests on a cushion of steam which prevents any concussion. The clam which grips the rope is fixed to a slide and screw, by which means the rope can be given out as required. When this operation is completed, and the strata cut up by a succession of strokes thus effected, the steam is shut off from the percussive cylinder, the rope unclamped, the winding engine put in motion, and the boring head brought up and slung from an overhead suspension bar (L) by a hook fitted with a roller (Z) to traverse the bar. The shell pump (H) is then lowered, the debris pumped into it by lowering and raising the bucket about three times, it is then brought to the surface and emptied. It is generally necessary for the pump to descend three times in order to remove all the debris broken up by the cutter at one operation.

A deep boring by this process has been put down at a maximum speed of one foot per hour through red sandstone, and at a depth of 1,000 feet at the rate of three inches per hour. The cutter can be lowered at a speed of 600 feet per minute and raised at more than half this speed. The frequency of the blows given by the cutter are between 20 *and* 30 per minute.

PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions subject to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by July the 19th, 1893.

Question 1—Give sketch in section of a good air crossing. Discuss its construction and object.

Question 2—How does it happen that where the water feeders of a mine are considerable, very little fire-damp is met with, and where little water is found much fire-damp may be expected?

Question 3—Whether do most explosions occur in the intake or return of a mine. Give reasons for your answer.

Question 4—How would you remove a pillar, 50 yards by 40 yards, in a mine whose inclination is 1 in 4, and is subject to creep?

Question 5—If a fireman finds gas in a place when making an inspection, and removes it, does the Act require him to report its presence?

Question 6—The rocks in the earth's crust are sometimes classified as stratified, unstratified, and metamorphic rocks. Mention some examples to prove clearly that you understand the meaning of the terms.

Question 7—Why are dip workings easier to ventilate than those having a rising inclination?

Question 8—Describe with sketch the construction and principle of the horse whim, and compare its useful effect with other winding appliances?

Question 9—A sinking pit is 300 yards deep, and the average diameter of the shaft 15 feet, the water is standing 120 yards up the shaft, and the shaft feeders are 260 gallons per minute. In what time can the shaft be pumped dry with a 14in. set, 8ft. stroke, and making 10 strokes a minute?

Question 10—What are the chief dangers sinkers are liable to, and how would you proceed to avoid them?

Question 11—Are any advantages gained

by splitting air, if so, what are they?

Question 12—What size hauling engine would you require to haul 100 tons per hour up an incline, 800 yards long, rising 1 in 5. Steam pressure in boilers, 60lbs. per sq. in.?

Competitors will please remember that not only is the correct answer required in calculations, but each step must be also shown, so that elementary students will be able to understand them.

ANSWERS TO QUESTIONS
In No. 15.

Question 1.—Describe the terms Chert, Gneiss, Mica-Schist, Tuff.

Answer.—1st.—Chert is a mixture of fine silica or sand with a portion of lime occurring in a hardened form, and is sometimes called hornstone. They are different names for the same thing. It is a hard flinty substance found in connection with some of the limestone rocks, just as flint is found in chalk, and it is valuable for road making. 2nd.—Gneiss is a rock composed of granite, mica, and felspar, in which the different parts are arranged roughly in layers, mica usually prevailing: but if hornblende wholly or partly replaces the mica it is called hornblende gneiss. 3rd.—Mica-Schist is a rock consisting of alternate lamina of mica and quartz. The original texture of the rock is quite obliterated. It readily splits into thin lamina or scales of different mineral matter. Such mode of division is called foliation, and rocks which so divide are called foliated or schistose. 4th.—From the opening of a volcano masses of rock are torn from the sides and lower portion, and are hurled by the steam into the air: these striking against each other, falling, and being ejected, are to a large extent reduced to fine dust. This dust, with the coarser material, is often converted into mud by the rain, and forms an accumulation on the sides of the volcano. This is known as volcano ash or tuff. It is spread out in a more or less stratified manner. Sometimes when it falls in the sea it is perfectly so, and may be mixed with various marine sedimentary matters, and may even contain fossils. Nevertheless though stratified, and to some extent aqueous, it will be proper to class it as an igneous rock.

W. T. GARTON,
Helen's Nook,
Golborne.

Question 2.—What thickness of cast-iron tubbing would you use in a shaft 18 feet diameter and 80 yards deep?

Answer.—As tubbing plates vary in thickness according to the diameter of shaft, and also the depth from the surface, I find thickness by the following. Formula:—Depth in feet × diameter in feet ÷ by 50,000 = co-efficient of rupture. Then add ·03 feet, constant number allowed for defects, thus giving your amount in feet, then × 12, which gives the answer in inches.

80 yards = 240 feet.

$$\frac{\overset{\text{DIA.}}{18 \text{ feet}} \times \overset{\text{DEPTH.}}{240 \text{ feet}}}{50{,}000} = \cdot 0864 \text{ feet} + \cdot 03 \text{ feet}$$

$= \cdot 1164$ feet $\times 12 = 1{\cdot}3968$ inches.—Answer.

I would reduce the thickness every 20 yards nearer the surface, but not to get below three-quarters of an inch.

WILLIAM SHAW,
233, Pankinston-by-Patna,
Ayrshire,
Scotland.

Question 3.—An airway passing 40,000 cubic feet of air per minute is split in two, one measuring 6 feet × 5 feet × 1,500 feet long, and the other 10 feet × 6 feet × 2,400 feet. How much does each split pass?

Answer.—For conveience call one split A and the other B, then the quantities vary directly as the areas, and inversely as the square roots of the resistances.

A:
- $6 \times 5 = 30$ square feet area.
- $6 + 6 + 5 + 5 = 22$ feet perimeter of airway.
- $22 \times 1{,}500 = 33{,}000$ feet of rubbing surface.
- $\frac{33{,}000}{30} = 1{,}100$ rubbing surface per sq. foot of sectional area of airway.
- $\sqrt{1{,}100} = 33{\cdot}2$ nearly sq. root of resistance.

B:
- $10 \times 6 = 60$ sq. feet area.
- $10 + 10 + 6 + 6 = 32$ feet perimeter of airway.
- $32 \times 2{,}400 = 76{,}800$ feet of rubbing surface.
- $\frac{76{,}800}{60} = 1{,}280$ rubbing surface per sq. foot of sectional area of airway.
- $\sqrt{1{,}280} = 35{\cdot}8$ nearly sq. root of resistance.

Then $(35{\cdot}8 \times 30) + (33{\cdot}2 \times 60) = 3{,}066$,

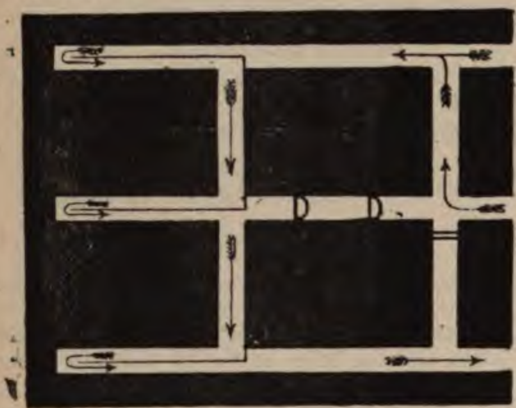
and $\frac{35{\cdot}8 \times 30}{3{,}066} \times 40{,}000 = 14{,}000$ cubic feet = the quantity that will pass in A.

Again $\frac{32 \cdot 2 \times 60}{3{,}066} \times 40{,}000 = 26{,}000$ cubic feet = the quantity that will pass in B.

JOHN GRAY,
Glebe Row,
Bedlington.
Northumberland.

Question 4.—Three levels are being driven simultaneously to open out a colliery, the lower level being the waterway. Describe with sketch how you would ventilate same.

Answer.—



D D Doors. —— Brattice.
== Stopping.))——> Direction of Current.

The above sketch represents three levels being driven simultaneously. The direction of the air current is shewn by the arrows, the air being conducted into the face by brattices, which if the seam generates much fire-damp must be carefully put in. At the holing of every new pillar a stopping of brick or stone, firmly cemented, is inserted in the last holing. The two lower levels are used as the intake, and the higher level the return.

FRANK GRAHAM,
Keepers Row,
Tow Law,
Durham.

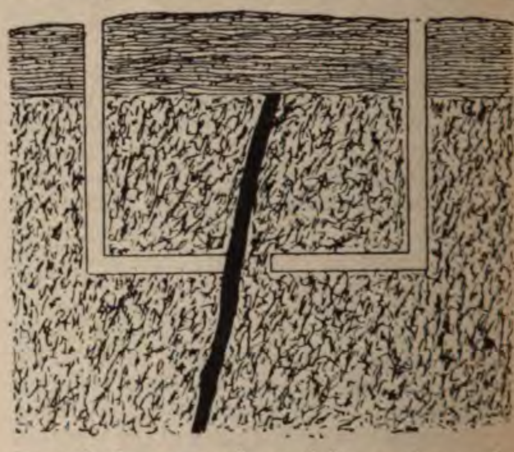
Question 5.—If a winding engine is drawing from two pits of different depths: No. 1 pit is 240 yards deep, and No. 2 pit is 180 yards deep, and the drum of No. 1 pit is 10 feet diameter, what will be the diameter of the drum of No. 2 pit?

Answer.—Having the diameter of one drum given, and to make the the cages arrive simultaneously at the top and bottom, the No. 1 pit is 240 yards $\times 3 = 720$ feet; and No. 2 pit is 180 yards $\times 3 = 540$ feet deep. Now if a shaft of 720 feet requires a drum of *10 feet diameter*, what will one of 540 feet deep require so as to have the same number of revolutions? This may be found by proportion, thus:—720 : 540 :: 10 = 7·5 diameter. A drum of 7·5 feet diameter would be required for No. 2 pit.

JOSEPH WALLWORK,
44, Johnson Street, Tyldesley.

Question 6.—What operations are performed in searching for a mineral vein?

Answer.—Several years ago the usual way to find, or rather attempt to find, a mineral vein was to make use of the *virgula divinitoria*, or divining rod. This consists of a forked branch in the form of a Y cut off a hazel tree; the person who bears it walks very slowly over the place where he suspects a lode or vein to be. The effluvia exhaling from the metals impregnating the wood makes it dip or incline which is a sign of discovery. Some dispute this fact, and deny its possibility; others convinced by the great number of successes attributed to it look out for the natural causes thereof. Lodes have been found by observing stones called "shode stones" in the bed of a river; these have been followed up as long as they were visible when the top of the lode has been found near the point of disappearance. This is called shoding. Another way of searching for a lode is by the method known as Costeaning.



Two shafts are sunk at right angles to the supposed direction of the vein, from 10 to 50 yards apart, and 8 or 10 fathoms in depth. Levels are then driven to connect the shafts one to another, so that if a lode run between them it is found by this level. If the vein be not found another shaft is sunk a short distance from the others, in the same line, and another level driven to connect it to the nearest shaft. This process is repeated until the vein is found. The sketch shews the manner in which the shafts and levels are

driven to find the lode. The lode is usually covered for several yards in depth by the surface soils, hence the reason for sinking small pits.

FRANK GRAHAM,
Keepers Row,
Tow Law,
Durham.

Question 7.—State the use of compressed air as a motive power in mines, the principle of an air compressor, and how the power is applied. Is it economical or otherwise?

Answer.—Compressed air can be used in mines as a motive power in many different ways. It is used for working pumping engines, driving endless rope engines, hauling engines, coal cutting machines, &c. It is the same in principle as the steam engine, but cannot work by itself, therefore the steam engine is used to store the energy in it. A pair of horizontal engines can be arranged so as to work the air compressor on the tandem system. The air compressor is placed immediately behind one of the engines whose cylinder has a through rod which is connected to the piston rod of the air engine. The cylinder of the air compressor is surrounded by a strong casing, which has a continual supply of cold water running into it to keep the cylinder cool. When we compress air we are doing work upon it and of course heat is evolved, and the air cylinder absorbs this heat in such a way that were it not surrounded with cold water it would soon be destroyed. When the compressor is at work the air is conveyed away from it, by means of pipes, to a receiver which may be placed at the bottom of the shaft. The receiver is fitted with a blow-off cock to take away the water of condensation. Another line of pipes is fitted to the receiver and conveys the compressed air to the pumping engine, or whatever it may be. The exhaust air sometimes freezes and blocks up the port holes of the engine, thus preventing it from working, but to remedy this the port holes should be as large, and the exhaust pipe as short as possible. This is termed "Icing-up." Engines in different seams can be worked by air taken from the leading air main or pipe. In point of economy it is preferable to steam in working motors placed at a considerable distance from the shaft, because the steam would condense and would produce a low useful effect. When compressed air is used the air of a mine is kept cool, and it also assists the ventilation. Its disadvantages are that it requires a steam engine to impart its work to it, and not more than one-quarter of this is given out as useful work by the air compressor. It requires extensive plant on the surface and this at a considerable cost.

G. W. SCOUGALL,
Bell's Place,
Bedlington,
Northumberland.

Question 8.—Give a detailed account of the treatment of wire ropes.

Answer.—Care must be taken in uncoiling wire ropes to prevent kinking. The coil should not be laid stationary, but should be placed on a turntable or reel and unwound from the outer end. Wire ropes must be carefully stored. They should on no account be placed on the grouud, but on planks raised several inches from the earth so that they may be free from damp. A tarpaulin should be kept round them and inspected from time to time. Wire ropes should not be worked round drums or over pulleys of insufficient diameter, and should not be allowed to strike against any hard substance while in motion. The maximum working load at average speed, including weight of rope, should not exceed $\frac{1}{8}$th of the breaking strain, or at high speed, $\frac{1}{10}$th of the breaking strain Ropes are seriously damaged by being overloaded. This should be carefully avoided. To prevent corrosion all working ropes should receive a regular dressing thoroughly laid on by passing the rope between roller brushes well fed with wire rope grease. A rope may be changed from a smaller to a larger drum, but not from a larger to a smaller one. This rule applies also to pulleys. It is well known that the greatest strain upon a pit rope is about where the rope lies on the pulley when the cage is at the bottom of the shaft. The best method adopted is to take the ropes off after they have been in use six months, and change them end for end. Spring bearings are sometimes fixed to the winding pulleys, and springs are also fixed at the bottom of the shaft to allow of the gradual settlement of the cage. These are said to greatly relieve the rope of the usual strain. A good deal also depends upon the carefulness of the engineman. If the load be started and stopped in a steady manner instead of jerking (as is often the case) the life of the rope would be materially prolonged. Pulleys or rollers should be fixed in the centre of the haulage way so as to prevent the rope from dragging along the floor. The course of the rope should be kept as straight as is convenient, and a sufficient number of

pulleys fixed at all turnings. I have known an instance where the haulage rope has only lasted for six months through neglect, and another rope of the same quality has with proper care lasted five times that period, in the same road, and subject to the same amount of work.

THOMAS BEST,
Railway Street,
Tow Law,
Co. Durham.

Question 9.—What are the advantages of dynamite over gunpowder? What special methods are required to develop these advantages, and what are the special dangers to be guarded against in its use? Give its composition.

Answer.—Dynamite has several advantages over blasting powder. It is seven times stronger than gunpowder, consequently smaller and shorter holes are required, and the charge can be concentrated at the back of the hole and produce better results on being exploded. Holes of an irregular shape can be charged with it on account of its plastic nature, which cannot be done with powder. For blasting in hard rock which requires to be shattered, or in wet ground, dynamite is decidely more preferable, being more rapid in its action, and it can be fired without inconvenience when under water. Dynamite has disadvantages with it. If stored for any length of time the glycerine separates from the unctious earth and exudes from the cartridge. If allowed to remain in a low temperature it freezes, and then it is dangerous to handle, as the heat developed in breaking it may cause it to explode. It should never be used when frozen, but should be carefully and slowly thawed. If dynamite be slowly raised to a temperature of about 370° Fahr. it instantly explodes, and several serious accidents have resulted by warming it. The composition of dynamite is 75% of nitro-glycerine, and 25% of unctious earth, the latter being employed to give the explosive a consistency which makes it easy and convenient to handle.

ROBERT DAVIDSON,
12, Grange Villas,
nr. Chester-le-Street,
Durham.

A liquid boils when the tension of its vapour equals the tension of the atmosphere.

NOTICES.

In this issue of our journal we have introduced several improvements; among others the quantity of matter given is greatly increased, consequent on the reducing of the size of the type in Answers to Questions. The only return which we ask for this extra outlay is that our readers will introduce this paper amongst their mining friends, it being our firm opinion that in its present form it only requires being known to be taken regular. Ours is the only mining paper published at a penny, and it was thought we were attempting a risky speculation when issuing one at that price. We undoubtedly were, but we counted on a comparatively large circulation, *i.e.*, for a mining journal. It is necessary, under present arrangements, to increase that circulation, and we ask our readers to help us to do so. We are now without rivals for the quality and quantity of the matter given at the price, so we must look forward to a speedy success.

The relation which the science of heat bears to all mining operations has induced us to have a number of articles written on this subject, the first of which will appear in next issue.

We are always pleased to receive suggestions from readers for the improvement of our journal, and all such suggestions will receive our careful consideration.—*Editor*.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

Cheques and P.O.O. to be made payable to STROWGER AND SON, Wigan.

SELECTION PRIZE.

The winner of this prize is Mr. Angus McLellan, 99, Knightswood, Maryhill, Glasgow, whose letter was the first opened containing the names of the two articles which received the most votes. "Mining" will be sent to him post free for six months in consequence. The most popular article was "Methods of Working Coal."

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MINING

A Journal devoted to the interests of Mining.

No. 18. Vol. I. JULY 27, 1893. FORTNIGHTLY ONE PENNY.

GENERAL INFORMATION.

The deepest shaft in the world is that of the Adalbert Lead Mine at Prizibuan, it being no less than 3,672 feet deep. The depth of the celebrated Virginia Consolidated Mine is 3,100 feet, and here the temperature was found to be 115° Fahr., so that the men could only work for twenty minutes at a time, and then return to an ice chamber, thus working two-and-three-quarter hours out of eight. Although working at this disadvantage it yielded, in six years, over £12,000,000 sterling worth of gold and silver.

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Professor DEWAR has recently succeeded in his endeavour to freeze air to a solid. The precise nature of this solid is at present doubtful, and can be settled only by further research. It may be a jelly of solid nitrogen containing liquid oxygen, or it may be a true ice of liquid air in which both oxygen and nitrogen exist in the solid form. The doubt arises from the fact that Professor DEWAR has not been able, by his utmost efforts previously, to solidify oxygen, which, unlike other gases, resists the cold produced by its own evaporation under the air pump. It thus becomes a question whether the cold produced is sufficiently great to solidify oxygen, or whether its mixture with nitrogen raises its freezing point, or whether it is really not frozen at all, but merely entangled among the particles of the solid nitrogen. The result, whatever may be its precise nature, has been attained by use of the most powerful appliances at command.

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A Mr. SETTLE has recently introduced a new Safety Cage. Its chief claims are its simplicity and effectiveness. Several experiments have been conducted with success. The chain or rope is attached in the usual manner on the top of the cage, but on either side of the rope is a hinged vertical link on the upper end of which is a horizontal lever, the lower end being hinged to a block capable of sliding up and down the vertical guide on each side of the cage. These links are horizontal but levers are so arranged that when the cage is suspended by the rope the blocks move up and down the rods with perfect freedom; in other words, two oval cams are drawn away from the guide-rods by the tension of the rope when the cage is being raised or lowered, but if the rope breaks the horizontal levers at once cause the cams to come in contact with the guide-rods, and the cage is supported in the shaft. A number of colliery managers and practical men who have seen the experiments with the working model have expressed great satisfaction with it. That something is necessary to arrest the cage in case the rope breaks is evident from the fact that an average of six lives are lost per annum through defective ropes and chains in colliery shafts, lifts, etc. The disadvantages of the invention noted, in our opinion, are its liability to come into action without the rope breaking, and the constant cutting of the rods which would take place at each of the landing places. For instance, if the cage was lowered at a good speed, the tension of the rope may not be sufficient to keep the levers in position. If this happened with men in the cage, the shock caused by the sudden stoppage would, in all probability, be sufficient to throw the men out, or at least result in them receiving some serious bruises. Again, the amount of coal wound from most collieries does not allow the engineman to reduce the speed on the cages approaching the landings so steadily as to keep the rope taut all the while, and, in very many cases, the cages arrive at the bottom with a rude shock. Were this to happen often, it would result in the guide being cut through.

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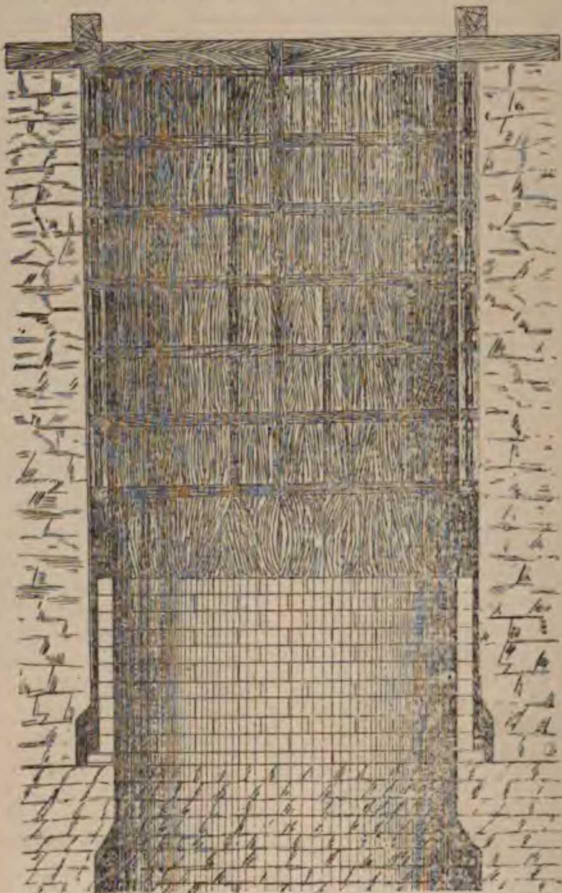
To find the weight of water in a column of pipes, square the diameter of the pipes in inches, and this will give the weight of water in pounds per yard. To find the number o gallons per yard, divide this by ten.

SINKING.

Chapter I.

THE information obtained by boring, the quantity of coal to be wrought, and the probable amount of water to be pumped (*i.e.* if the shaft is to be used for pumping also) will enable the engineer to determine what size of shaft will be necessary to open out the estate. There are various forms of shafts used in mining, viz.: oblong, polygonic, elliptical, and circular. Of these the circular is the strongest, and is, in fact, the only form now sunk in England for coal mines. The size of the circular shaft ranges from twelve to eighteen feet in diameter, but it is seldom any shafts are now sunk less than fifteen feet, and recently several shafts of twenty feet diameter have been put down. There are many advantages derived from having plenty of room in the shaft, while the cost of one large shaft is not near so much as two small ones to the same depth.



The site being chosen for the shaft a circular patch of ground is staked out by driving pegs into the earth at short distances apart, a few feet larger in diameter than the proposed site of the finished shaft. The earth is then excavated with pick and spade inside these stakes to a depth of about nine feet, according more or less to the nature of the ground. If the ground is soft and loose it may not be possible to sink so deep at one operation, through the sides crushing in. Oak segments (see lower figures) about five inches square, are prepared so that about eight of them will form a circular ring, called a crib. These are then lowered into the excavation and fastened together with cleats about $1\frac{1}{2}$ inches thick and the width of the segments, which are fixed both above and below each joint. The crib is now laid on a level bed at the bottom of the pit, backing deals of wood, 1 or $1\frac{1}{4}$in. thick and say 12 feet long, are placed vertically behind the crib, and to about half its depth, round the sides of the pit. Another crib is then placed three feet above the first, from centre to centre, and punch props are

placed from four to six feet apart between them, to support the upper crib. Three other cribs are set in a similar manner above the others, punch props being inserted between them. The topmost crib will now be on a level with the backing deals, and three feet above the surface of the ground. This will allow of the rubbish excavated being tipped from the raised part thus formed, until the bricking is commenced, and a more substantial staging erected. Four baulks of timber are also laid across the top of the pit and stinging deals are nailed to them, and to the inside of the cribs to ensure them being kept in position. The sinking is again commenced, of a less diameter than at first, but gradually widening to its original dimensions, and is carried to a depth of say six feet. If a good stone head be not encountered in this depth it will be necessary to fix two other cribs with backing deals behind them in the same manner as at first. The top of the backing deals in the second case will come half-way up, behind the first crib laid. These operations must be continued until the strata is strong enough to form a foundation for the brickwork. The material will be raised from this depth in stages or lifts, or by means of a jack-roll.

Immediately the stone head is reached the bricking should commence at once. The sides are sheared back a little at the bottom, to give room for the laying of the crib, he surface of the rock on which the crib is to be laid is truly levelled, the segments of the crib brought down the shaft, fastened together, and put in position exactly level and concentric to the shaft. The cribs used for the bricking may be either timber (oak) or cast-iron. The iron segments are cast hollow, about thirteen inches in the bed, of three-quarter-inch metal, and open on the fore side. Sheathings of timber are placed between the joints of the segments when they are bolted together. The walling, which is usually of nine-inch brickwork, is then built on the crib and carried up the shaft, the space behind the bricks being packed with broken stones, etc., and grouted with cement. The bricking being finished, the sinking is again commenced, but at a less diameter than the finished size of the shaft so as to support the bricking. It is gradually widened again and sunk down several yards, when another crib is laid, and the walling built as previously stated. Then the protruding rock left above it is cut away, a small portion at a time, and the bricking is built up to the crib. In this manner the whole of the rock is taken out and the older bricking is gradually snpported by the new portion. Another method of fixing the cribs is to bore holes, say twelve, about two feet deep and about two inches diameter, in the sides at equal distances; iron plugs or bars, three feet long and of a diameter suited to the holes, are then driven in, and the cribs placed upon them and levelled. This may be done by placing pieces of timber, an inch or two thick as the case requires, between the bars and the crib. The bricking is then carried up to the ring above, and this can be done with greater despatch, and at less cost, for it can be built to the higher crib without any interference from the rock left to support the ring in the other method.

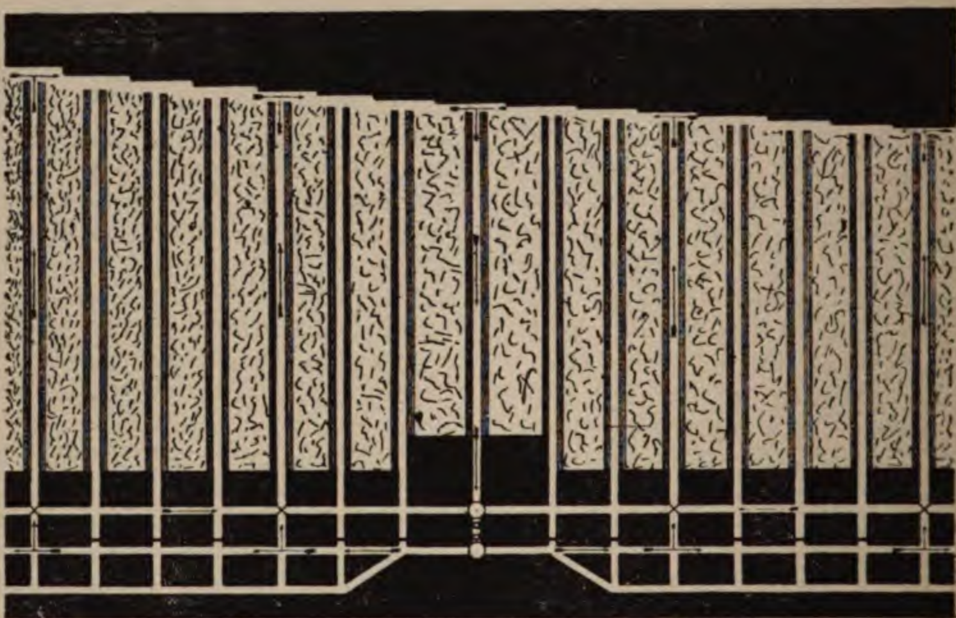
(*To be continued.*)

To measure Coal Heaps.—If the ground on which the heap rests and the top of the heap be approximately level, one-half the sum of the top and bottom areas × the average height = cubical contents of heap.

METHODS OF WORKING COAL.

Longwall.

THIS method of working is very simple, and its chief feature is the removal of the whole of the coal in one operation. It is absolutely necessary that pillars be left for the the support of the shafts whatever system is adopted, consequently two or more narrow bords or roadways are driven from the pits in level direction. These are continued until they are thought to be a sufficient distance from the pit to allow of the in the roadways, and to build pack walls on each side of the road with the debris thus obtained. The roof between these roads is allowed to settle on the waste behind the working places. This is the general description of longwall workings, but there are numerous modifications of this system, although the principal of removing the whole of the coal on a wide face and stowing the waste with refuse is common to all. The illustration shows a method of Longwall, but instead of the wide-work being commenced immediately



Plan of Longwall Workings.

coal being worked in a wide face, several hundred yards in length. These workings are carried forward and extract all the coal as they advance towards the boundary. The space thus left by the removal of the coal is stowed, with the exception of narrow places, which are left open for ventilating and conveying purposes, with the dirt which may be got with the coal. It is usual to rip down a few feet of the rock which forms the roof of the mine after the cutting of the shaft pillars, other pillars are left between the levels as a support, and the wide-work is commenced from the higher side of these pillars in an upbrow direction.

When the coal is worked in this manner from the pit towards the boundary it is known as "*working-out*." In some instances bords or strait places are driven immediately to the

boundary, and the coal is then worked in widework towards the pit, this being known as "*working-home*." The advantage of the first method is that a large quantity of coal can be obtained soon after the opening of the pit, while the second requires considerable time for the roads to reach the boundary, but it possesses the advantage of having better and fewer roads, which are maintained at far less expense, and these are continually decreasing in length, whereas by the other method they are ever increasing in length and number.

The longwall system possesses many advantages over bord and pillar; indeed some practical men go so far as to say that the bord and pillar method should be used only after longwall workings have been given a fair trial and failed. The circumstances under which longwall workings are applicable and the advantages appertaining thereto have been discussed in an early number of this paper.

PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions subject to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by August 3rd, 1893.

Question 1. (M.)—The crown of the arch at the pit eye is crushing, through the removal of the pillars near the shaft. Explain with the aid of a sketch, how you would proceed to remedy this defect.

Question 2. (E.)—Why is it not a proof of good ventilation in a mine to have a very good current of air in a small place?

Question 3. (E.)—What is an adit level? Give particulars of any remarkable adits of which you have heard, or with which you may be acquainted.

Question 4. (E.)—Describe, with sketch, the methods of under and over hand stopping on a mineral lode.

Question 5. (A.)—What trouble arises from the presence of faults in the working of coal seams?

Question 6. (A.)—State the advantages and disadvantages of the various forms of shafts used in mining.

Question 7. (H.)—What size of hauling engine would be required to haul 100 tons per hour up an incline 2,000 yards long, rising one in five, steam pressure in boiler being 60 pounds per square inch? (Show each step of calculation.)

Question 8. (A.)—What amount of fresh air should be provided per minute, for each man, horse, and light, in a colliery?

Question 9. (M.)—When the roof in a goaf first begins to "weigh" in a fiery mine, what dangers would you apprehend, and what precautions would you take?

Question 10. (M.)—A district has been sealed off in consequence of a gob fire. How would you proceed to open it?

Question 11. (A.)—Explain, with sketch, the method of timbering a level, first, in moderately soft ground; second, in a comparatively wide road.

Question 12. (M.)—If 30,000 cubic feet of air is being produced in an airway 1,200 feet long, 5 feet high, and 8 feet wide, how many feet would be produced if the air was split into three splits, the first being of the above dimensions, the second 1,500 feet long, 8 feet wide, and 7 feet high, and the third, 1,800 feet long, 6 feet high, and 9 feet wide, the power remaining the same?

Competitors will please remember that not only is the correct answer required in calculations, but each step must be also shown, so that elementary students will be able to understand them.

The letters E. A. H. and M. in front of the questions are to denote to which class the question belongs, whether Elementary, Advanced, Honours, or Managers.

HEAT.—By Calor.

Chapter I.
WHAT IS HEAT?

According to the dynamical or mechanical theory which is now most universally held, heat is a state or condition of matter. It is due to the vibrations of the particles of the body evolving round each other. Each particle is however so small, and the motion so rapid, that they are imperceptible to the human eye even with the aid of the most powerful instruments. Temperature, as impressed upon our minds in such words as hot, warm, cold, and cool, is simply the different stages of heat as they affect our senses. The sense of touch which we employ principally to enable us to state the intensity of the heat of a substance cannot be relied upon to compare the temperatures of two bodies. We can only say whether the body is hot, or cold, or some other such vague term, according as they extract from, or give heat to that organ of our body which is in close proximity to it. Touch with the hand some pieces of iron, wood, and flannel, which are in the same room, removed from any source of heat, and consequently at the same temperature. The iron will feel colder than the wood, and the wood colder than the flannel. Again, heat these substances to a temperature above that of our bodies, and examine again; the iron will feel warmer than the wood, and the wood warmer than the flannel. We therefore see that if we had no other means of testing temperature than the hand we should come to the conclusion that one of these articles was warmer than another. The explanation of this seemingly curious behaviour on the part of our hands lies in the fact of one article being a better conductor of heat than the other. But more of this anon. To show that both hands cannot be depended upon to indicate even the same temperature, take three vessels; into the first pour some hot water, into the second lukewarm water, and into the third cold water. Next place one hand in the hot water and the other in the cold water for a brief period, and then plunge both hands into the lukewarm water. The hand which was formerly in the hot water will now feel cold, and the other hand will feel warm.

As my readers are aware from every-day experience the effect of heat on all substances, whether gas, liquid, or solid (with one or two exceptions) is to cause them to expand, the rate of expansion under ordinary circumstances is the same for a definite amount of heat. Advantage is taken of this quality of heat to enable us to test accurately the temperature of a body. To do this it is evident that some definite points must be chosen as a standard to allow of comparisons. The points naturally chosen are the freezing and boiling points of water. Whatever substance is to be used as a thermometer, its volume is taken whilst at a temperature which is just sufficient to melt ice, and again taken in a temperature equal to that of boiling water. The intervening space between these two points is divided into a number of equal parts called degrees, and the temperature of any other body compared with water, may then be ascertained by it. A bar of iron could be used to read temperature were it not for its small extension for a rise in temperature. Unless the bar be very long, and be subject to great heat, the increase in length would not be visible to the naked

eye. We therefore see that for ordinary temperatures iron is useless as a thermometer. Liquids expand more than solids, and gases more than liquids for a definite temperature, so that it appears from a first consideration that atmospheric air should be suitable as a thermometer. In fact air was the substance employed in the construction of the first thermometer by Galleo. It consisted of a glass bulb with a long neck. The air in the bulb was first heated, and then the neck was plunged into some coloured liquid. As the air in the bulb cooled the liquid rose up the neck. Next certain temperatures were marked on the glass according to the position of the glass at those temperatures. The higher the liquid in the neck, the lower the temperature, and *vice versa.* A thermometer of this description possesses several advantages. It gives large indications for a slight change in the temperature, and the air requires less heat to warm it than would a liquid thermometer, so that it is rapid in its indications. It possesses the following disadvantage. The liquid in the tube being open to the atmosphere, we must consult a barometer in conjunction with a thermometer before the temperature can be ascertained. From the foregoing, it is obvious that neither solids nor gases can be used conveniently as a thermometer for ordinary temperatures. We must therefore have recource to the liquids. The kind of liquid to be used is the next consideration. A water thermometer is out of the question, as it would be useless below 0°C. and above 100°C. Alcohol is inapplicable for high temperatures, its boiling point being only 79°C., but for low temperatures alcohol is used as it is found to resist coagulation even at very low temperatures. The one most generally used is the mercurial, the freezing point of mercury being —40°C., and its boiling point 350°C. Not only is this substance chosen for its range on either side of the ordinary temperatures before altering its state, but also for its comparative uniform expansibility. The construction, methods of reading, etc., will be discussed in next chapter.

To be continued.

EXPLOSIVES.

Chapter II.—Dynamite.

DYNAMITE is produced by the absorption of nitro-glycerine in some porous substance. Numerous explosives have been formed, which may be classed as dynamites; the only difference between each being the percentage of nitro-glycerine used, and the using of various bases. These dynamites may be grouped into two classes according to their base, viz.:—(1) Those which have some inert or non-explosive material for a base such as clay, the sole object of which is to absorb the nitro-glycerine. (2) Those which have an active or explosive base as gunpowder, guncotton, etc. The following are some of the dynamites introduced, with their several ingredients:—

Kieselguhr.—This is the original dynamite, and consists of nitro-glycerine absorbed in a porous clay which is found in Hanover, and is known as kieselguhr. This clay will absorb from three to four times its own weight of nitro-glycerine. The usual amount used in practice is three times, and it has the advantage of retaining this quantity even under great pressure.

Vulcanite.—Mealed gunpowder is used in this explosive as the base with the nitro-glycerine, the idea being to obtain the power of the gunpowder to perform useful work, as well as acting as an absorbent. That the object sought for is attained may be understood by the numerous explosives produced on these lines.

Litho-fracteur.—This explosive takes the form of a plastic clay, and is composed of the following ingredients:—Nitro-glycerine, 55 per cent.; kieselguhr, 21 per cent.; charcoal, 6 per cent.; bi-carbonate of soda, 15 per cent.; manganese oxide, 3 per cent.

Horsley Powder consists of nitro-glycerine and chlorate of potash.

Blasting Gelatine.—This is a very powerful explosive and is composed of 93 per cent. nitro-glycerine, and 7 per cent. nitro-cotton.

Brain's Powder contains nitro-glycerine, chlorate of potash, and coal dust.

Atlas Powder is composed of nitro-glycerine, nitrate of soda, carbonate of magnesia, and wood fibre.

Forcite consists of nitro-glycerine mixed with a special cellulose.

Carbonite is composed of carbon, 10 per cent.; nitro-glycerine, 90 per cent.

Gelatine Dynamite consists of a thin blasting gelatine (80 per cent.) mixed with nitrate of potash and wood pulp in proportion. Used principally for blasting rock.

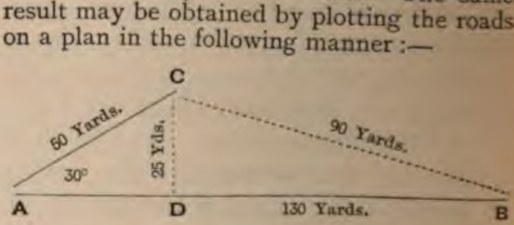
Von Dahmin's.—This is quite different from any of the other dynamites, in so much that it is claimed to withstand extreme cold without freezing. This effect is produced by the admixture of some substance to the nitro-glycerine. This explosive is a German invention and has not been introduced in England. If it possesses the advantage claimed for it, the sooner it becoms generally used the less will be the accidents occurring through the thawing of the usual dynamite explosives. The advantages of dynamite over powder, the special methods required to develop these advantages, and the special dangers to be guarded against in its use, were discussed in the "Answers to Questions" in last issue.

To be continued.

ANSWERS TO QUESTIONS In No 16.

Question 1.—Two roadways commencing at the same place are being driven by lines; the angle enclosed between the lines is 30 degrees; one road is 50 yards, and the other 130. What distance are the ends of the roads apart, and what area of coal do they encompass?

Answer.—The distance between the ends of the roads is 90·23 yards, and the area encompassed is 1,625 yards. The way I have worked the question is as follows:—50 × the sine of 30° which is ·5 = 25. Now we have a right-angled triangle whose hypothenuse is 50 and perpendicular 25, then $\sqrt{(50^2 - 25^2)} = 43{\cdot}3 =$ base. Now, $130 - 43{\cdot}3 = 86{\cdot}7$, and $\sqrt{(86{\cdot}7^2 + 25^2)} = 90{\cdot}23$, the distance between the ends of the roads. Now, $\frac{130 \times 25}{2} = 1{,}625$ yards, the area enclosed by the two roads. The same result may be obtained by plotting the roads on a plan in the following manner:—



Draw a horizontal line AB across the paper and measure off with any scale 130 yards. Next place a protractor on this line with its centre at the point A, plot off 30° and measure 50 yards (shown at A C). The distance between the points A and B will

now be found by measuring with the scale, to be 90 yards. The area enclosed in this triangle will be found by multiplying the base A B by one-half of the perpendicular C D. The perpendicular measures 25 yards. Then $\frac{130 \times 25}{2} = 1{,}625$ square yards.

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Question 2.—Proto-carburetted hydrogen gas. What percentage of this gas is required to be mixed with air to enable you to detect its presence? What is the weight of the gas compared with atmospheric air?

Answer.—With a good safety lamp 2½% of this gas may be detected. The presence of 2½% of fire-damp in air may be detected by the common Davy lamp. By the the use of Liveing's Fire-damp Indicator the presence of one-half % of fire-damp may be observed. This instrument consists of two small spirals of platinum wire so arranged that by the turning of the handle of a small magneto-electrical machine within the instrument the spirals can be heated to redness. The spirals glow with equal brilliancy when the air is free from gas, but if gas is present the spiral to which the air of the mine has access is seen to glow with greater brilliancy than the other one. The percentage of gas present is indicated by a scale placed between the spirals. A still smaller percentage of fire-damp may be detected by the Pieler lamp which is enclosed in a tin case with a blue glass pane. On the outside is a scale to show the percentage of gas present. The flame is adjusted to zero in still air, and if fire-damp be present the flame elongates, and the percentage of gas is shown on the scale. By the use of this lamp one-quarter % of fire-damp can be detected. The weight of gas is $12 + 1 + 1 + 1 + 1 = 16$. $16 \div 2 = 8$, and $8 \div 14{\cdot}41926 = {\cdot}555$, which is the weight of proto-carburetted hydrogen as compared with air.

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Question 3.—State your experience with the barometer and thermometer in connection with mining. Supposing you have a mine 150 yards in depth, and another 250 yards in depth; what will the difference in the reading of the two depths be? What is a thermometer, and how is the ventilation of a mine affected by the changes of this instrument?

Answer.—I have seen three kinds of barometers, the cistern, the syphon, and the wheel. The cistern is the one most commonly used in collieries, but they are all intended for the same purpose, that is, to show and measure the variations of the atmospheric pressure, and on this account they are used in colliery workings. They indicate the friction of air in mines, and they shew this by the reduction of pressure between the intake and return, which is the power spent on the friction. A fall of the barometer reduces the pressure of air in the airways of a mine. Suppose that an underground road 1,000 yards in length, and the perimeter of the same is 30 feet or 9×6. The total reduction of pressure in this road when the barometer falls from 31 to 28½ inches would be $1{,}000 \times 3 = 3{,}000$ feet in length; $3{,}000 \times 30 = 90{,}000 \times 180 = 16{,}200{,}000$ pounds total reduction of pressure. The reduction of atmospheric pressure as shown by a barometer is a warning that an increased quantity of gas may be expected. Gases penned up in abandoned excavations will expand with a falling barometer. The barometer is known to increase one inch in height for every 930 feet in depth, so that if the barometer reads 29 inches at the bottom of the 120-yard shaft, it would read 29·322 inches nearly at the bottom of the 250-yard shaft, therefore difference of reading would be ·322. The Thermometer consists of a glass tube filled with mercury. It is used to measure the temperature of air, and to indicate the expansion of gases by heat. It is principally used in mines for ascertaining the difference in temperature between the down-cast and up-cast shafts, and the variation and action of temperature upon the ventilation is shown by reducing or adding to the weight of air, as the higher the temperature the lighter the air, and the greater the difference in each shaft the better the ventilation. The reading of the thermometer increases 1° F. for every 20 yards in descent, *i.e.*, there would be a difference in the readings of 5° F.

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Question 4.—How do you measure the air in a mine, and what speed should it travel through the workings?

Answer.—The quantity of air passing in a mine is found by taking the sectional area of a drift, and multiplying by the velocity of the air in feet per minute. To measure the air a small instrument called the anemometer is used, of which there are several kinds. In Davis's anemometer there are several small circles which by index hands register the number of feet of air per minute in tens, hundreds, thousands, &c., according to the revolutions of a small wheel fitted with vanes of vulcanite, which are placed obliquely to the air current. It is exceedingly portable, being only four inches in diameter. By the pressure of a small spring button, the hands again return to zero as the button is gently liberated. Suppose the quantity of air was required that was passing in a drift five feet high, and six feet wide. I would adjust the instrument to zero, and multiply the height of the drift by the width, which would give the sectional area of the drift, thus, $5 \times 6 = 30$ feet area. And if the finger of the anemometer registered 500 after being held in the air current for the space of one minute I should then multiply the area by 500. Then the quantity of air passing per minute would equal $30 \times 500 = 15,000$ cubic feet of air per minute. It is advisable to take the velocities of the air current at the centre, top, bottom, and sides, and average the lot, as it is found to travel faster in the centre than at the other portions, on account of the rubbing surfaces. The method of measuring air by powder smoke need not be described, as it may be considered to be obsolete. A convenient rate for the air to travel in the workings is three feet per second, and in the main intakes should not exceed ten feet per second.

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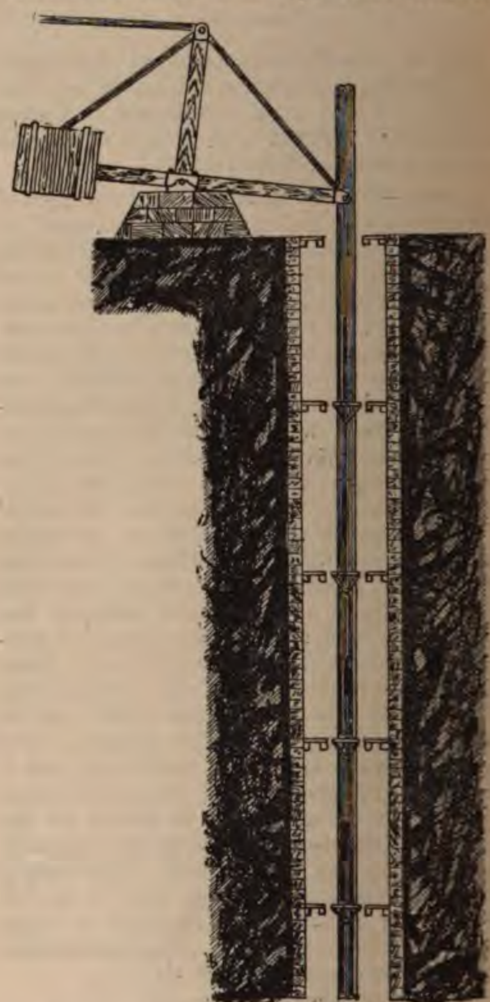
Question 5.—Describe the principle and construction of a man-engine, with sketch.

Answer.—The man-engine is a mechanical contrivance used in some of the large mines in Cornwall, for lowering the miners to and raising them from their work. The man-engine is of German origin, where it is called the "*Fahr-kunst.*" It was carried into effect by some of the German miners who attached steps to the pump rods. In Cornwall, it was first introduced by Mr. Loam, in 1835, at the Tresavean Mine, to whom the Royal Cornwall Polytechnic Society made an award of £500 for the great boon he had conferred on the miners. The man-engine consists of a beam of wood about eight inches square in section, reaching from top to bottom of the shaft in successive lengths of 18 or 20 feet; these lengths are attached and fastened together by overlapping cleats and strong bolts. Every 12 feet there is a step fitted to the beam, and at each side, on the shaft sides, is attached a bracket or "sollar," so that a person, by taking advantage of the up-stroke of the rods or beam, may ascend from the bottom to the top in a few minutes. He stands upon the bottom step



of the beam and is raised up to the first "sollar" in the shaft side on which he steps and remains during the down-stroke, then he steps onto the second step of the beam and is raised up to the second "sollar" in the shaft side, and so on till he reaches the surface. An engine is required to give a vertical reciprocating motion to the beam. The great drawback of the man-engine is its

first cost. To supply a man-engine with driving gear, complete, to a depth of 200 fathoms, exclusive of the shaft itself, cannot be taken at less than £2,000, with £500 or more per year for maintenance; and yet it is cheaper in the long run than the old ladders so extensively used.

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East Stanley, R.S.O.

Question 6.—Name the three great divisions of the Carboniferous formations, and explain under what conditions the useful minerals are found that are contained in them.

Answer.—The three great divisions of the Carboniferous formation are:—1, The Coal Measures which form the uppermost part of the division, and are divided into three series: the lower, middle, and upper. 2, The Millstone Grit which comprises a group of sandstones and grit, with shales and clays, and a few thin seams of coal. 3, The Carboniferous Limestone, sometimes called "Mountain Limestone," because it forms some of the principal mountain masses in England. The thickness of this formation is about 20,000 feet. Geologically, it is situated in the Palæozoic or Primary epoch, above the Devonian and Old Red Sandstone systems. The useful minerals that are found in them such as the bituminous coal of Great Britain, Ireland, France, Belgium, Russia, United States, and Novia Scotia, and the anthracites of South Wales and Pensylvania, are found in beds or seams separated from each other by more or less thick strata. These seams lie more or less horizontally in the strata, forming basins, which constitute the various coalfields. Ironstones are found in beds and nodules consisting of carbonate of iron and clay, the average yield in Staffordshire, Worcestshire, and Shropshire, being about 40%. Scotland yields about 6%. Lead ore is found in the Carboniferous Limestone in segregated veins in Durham, Northumberland, Cumberland, and Derbyshire.

SAMUEL THORPE,
Chevet View,
Byhill,
near Wakefield.

Question 7.—What precautions would you take when ripping down top caunch for the erection of a crossing in a dry and dusty mine?

Answer.—If the crossing had to be shot out I would not allow any shot to be fired until a proper inspection had been made where the shot had to be fired, and all accessible places within a radius of twenty yards, at the same time of firing, have the road and sides and all parts and places where dust is lodged thoroughly watered. If, then, such watering should injure the floor, roof, and side, I would dispense with the watering, and have the explosive used immediately connected with water, or to be of such contrivance so that it will not inflame the dust. If such place was the main haulage, or connected to it, no shot should be fired unless the above conditions were carried out and all workmen removed from the seam except those attending the shot-firing, and such persons, not more than ten, necessarily employed to attend to the ventilation furnaces, boilers, engines, machinery, winding apparatus, signals, horses, and for inspecting the mine. The following are the requirements of the C.M.R.A. in dry and dusty mines:—General Rule 12 of the C.M.R.A. *(clause f.)* says—in any mine which is dry and dusty, no shot shall be fired except by or under the direction of a competent person appointed by the owner, agent, or manager of the mine. *Clause h.*—If the place where a shot is to be fired is dry and dusty, then the shot shall not be fired unless one of the following conditions is observed, that is to say: (1) Unless the place of firing and all contiguous accessible places within a radius of twenty yards are, at time of firing, in a wet state from thorough watering or other treatment equivalent to watering, in all parts where dust is lodged, whether roof, floor, or sides, or (2) In the case of places in which watering would injure the roof or floor, unless the explosive is so used with water or other contrivance as to prevent it from inflaming gas or dust, or is of such a nature that it cannot inflame gas or dust. *Clause i.*—If such dry and dusty place is part of a main haulage road, or is a place contiguous thereto, and showing dust adhering to the roof and sides, no shot shall be fired unless (1) Both the conditions mentioned in clause *h* have been observed, or (2) Unless such one of the conditions mentioned in clause *h* as may be applicable to the particular place has been observed, and moreover all workmen have been removed from the seam in which the shot is to be fired, and from all seams communicating with the shaft on the same level, except the men engaged in firing the shot, and such other persons, not exceeding ten, as are necessarily

employed in attending to the ventilating furnaces, steam boilers, engines, machinery, winding apparatus, signals, or horses, or in inspecting the mine.

JOHN GRAY,
Olivers' Buildings, Glebe Row,
Bedlington,
Northumberland.

Question 8.—Describe with sketch the operations of getting coal in a seam of the following section—roof good, top coal one-and-three-quarter feet, dirt parting one foot, bottom coal three feet.

Answer.—

JOHN GRAY,
Glebe Row,
Bedlington,

Question 9.—What are the leading groups or formations of stratified rocks? Describe the chief mineral contents of each.

Answer.—There are thirteen groups of stratified rocks which come under the immediate notice of the miner, and are as follows:—POST-TERTIARY: Stream tin of Cornwall in river gravels; alluvial gold of Australia and California; copper deposits of Lake Superior. PLIOCENE: Large deposits of bones and excrement of fishes, known as coprolites, got by a rude species of mining in Suffolk and Essex, and used for making artificial manures. MIOCENE: Lignite beds of Bovey Tracey, in Devon, Antrim, Mull, Austrian Alps, Germany, and Vancouver Island. Some of the lignites or brown coals of Ireland are of this age. EOCENE: Lignites of Tyrol, Venetian Alps, and Lower Styria: gypsum of Montmartre. CRETACIOUS: Iron ore beds of Sussex, copper ores of Algiers and Chili, lignites of Gossam, in the Australian Alps, and of Santa Fe de Bogota, in South America: coal of Moravia. OOLITIC AND TRIASSIC: Coal of Kimmeridge, Borra, Fungkerchen, and Steierdorf, in South Hungary, Pensylvania; brown coal of North Germany; copper deposits of Bannat, in Austria, and of Department l' Aveyron in France; iron ores of Cleveland and Rosedale in Yorkshire. TRIAS: "Litterkohle" of South Germany; coal of Virginia, U.S.A., and of New South Wales (part); copper of Chessy, in France, Lake Superior, Connecticut, New Jersey, and Pensylvania (according to some authors).—PERMIAN: "Branschiefer" of Germany and Bohemia; coal of India and of New South Wales (part); copper deposits of the west side of the Ural Mountains, Mansfield in Russia, Hesse, Thuringia; rock salt of Worcestershire and Cheshire; clay iron-stone of the coal Measures. CARBONIFEROUS: Coal measures of Great Britain and Ireland, France, Belgium, Prussia, Spain, Bohemia, Novia Scotia, Moravia, United States; anthracite of South Wales, Ireland, and Pensylvania,; coal of New South Wales (part); lead mines of Derbyshire, Cumberland, Northumberland and Durham. DEVONIAN: Coal of New South Wales (part); tin, copper, iron, and lead lodes of Cornwall and Devon; copper lodes of Wexford. SILURIAN: Anthracite of County Cavan, Ireland, Isle of Man, and and Norway; Graphite of Cumberland; copper of the east flank of the Urals. CAMBRIAN:———. LAURENTIAN: Graphite beds of North America; copper of Norway and Sweden. The above is an abridged description by J. H. Collins, F.G.S.

JOHN N. WARDELL,
12, West Street,
Cross Lanes
East Stanley, R.S.O.

NOTICES.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

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GENERAL INFORMATION.

THE EFFECT OF BAROMETRIC* FLUCTUATIONS ON GASES.

The daily papers in mining districts are constantly warning the miners to beware of an increase of gas being given off in the mines. These warnings are deduced from changes in the height of the barometer. Parliament also makes the stationing of barometers about a pit compulsory. Yet, men of ability, assert that a change in the barometer has no effect on gases underground, whilst others say that a fall in the barometer means an increase in the quantity of gases given off; and these assertions are not the result of any pet theory, but of actual and varied experiments. Mr. John Milni, F.R.S., F.G.S., in a paper read before the Federated Institute of Engineers, writes—The following few extracts epitomised from the writings of M. Chesneau, and the report of the Austrian Fire-damp Commission, the writer assumes to be fairly representative of the experiments of those who have investigated the relationship between the escape of fire-damp and fluctuations in barometric pressure. M. Chesneau, in the paper already referred to, gives an interesting summary of observations which have been made on the escape of fire-damp and atmospheric pressures. M. E. Chatelier, after a critical examination of the experiments made by Galloway between 1868 and 1873, arrives at the conclusion that it is doubtful if variations in atmospheric pressure have any relationship to the escape of gas. M. Schondorf, who made observations in the Saar basin, concluded that barometric fluctuations directly affected the escape of gas from the Goaf. M. Nasu, by carefully examining the gas issuing from a particular bed, found that it increased with a barometric fall, but, as pointed out by M. Chesneau, it is likely the increase may have been solely due to a greater escape from the area enclosed by stoppings rather than an increased rate of distillation from the coal. The experiments of M. Hilt, led to the conclusion that gas increased with a barometric fall and *vice versâ*, but the examination of M. Hilt's results by Messrs. Mallard and le Chatelier, showed that great barometrical falls only correspond with the appearance of small quantities of gas, whilst in regions cut off from goaf the correspondence was barely evident. In case of one considerable fall at one mine, gas decreased, and at another increased. The conclusions arrived at by M. Kohler at certain mines in Silesia, were as follows:—(1) The quantity of gas diminishes with a rise of the barometer, and *vice versâ* (2) The quantity increases proportionately to the rate at which the barometer falls, and *vice versâ* (3) The quantity of gas disengaged is not absolutely dependent on the height of the barometer. (4) If the barometer rises rapidly, and after that very gently, or remains steady at its maximum, a small increase of gas takes place; inversely if it falls rapidly, and then gently rises or remains long at a minimum a diminution in the quantity of gas commences. The writer's conclusions are—(1) That a local barometrical fall is directly connected with the escape of gas from old workings and goaf. (2) That local barometrical changes have—at least in the majority of cases—but little if any appreciable effect on the escape of gas from coal.

* The construction and principle of the Barometer will shortly be described in the articles on Heat.

A NEW FAN.

GUSTAVE HANARTE, Mons, Belguim, has invented a new fan, its object being to reduce to a minimum the eddies and friction produced by recompression of the air. The air is forced by the blades of the fan into a convergent pipe or adjutage, so as to effect its rapid recompression before it is expelled into a divergent chimney. The outlet orifice of the convergent adjutage may be regulated by an abturator, so that air will be compressed more or less according to the greater or smaller depression of the same as it passes into the fan.

HEAT.—By Calor.

Chapter II.

Mercurial Thermometer.

THE construction of a mercurial thermometer is as follows:—A tube with a uniform bore is selected (see fig. 1), one end is melted, closed up, and blown into a spherical bulb, the other end remains open and is formed into a cup-like shape. A small quantity of mercury is introduced into the cup, and the bulb at the other end is heated by means of a small lamp. This causes the air in the bulb to expand, and a portion of it escapes by forcing a way for itself through the mercury in the cup. The flame is next removed and the bulb allowed to cool, this contracts the air in the bulb and forms a partial vacuum; and as fresh air cannot return through the mercury, the pressure of the atmosphere forces some of the mercury down the stem into the bulb. A little more mercury is then added to that which remains in the cup, and the same process is repeated until sufficient mercury is in the tube. The cup is next cut off and the flame again applied to the bulb until the mercury is made to boil and reaches the top of the tube; when this occurs the end is melted and closed up, or what is known as "hermetically sealed." The mercury then shrinks down the stem to some point according to the temperature of the room. The next step is the

Graduation of the Thermometer.

As was stated in the last article, the points chosen to effect this are the freezing and boiling points of water. To ascertain the freezing point, the bulb and part of the stem is placed into a vessel containing pounded ice or snow in a melting state, the water from the snow or ice escaping through a small hole in the bottom of the vessel, in order to keep the temperature of the inside of the vessel at the correct temperature. After about ten minutes the position of the mercury in the tube is noted and a scratch is made with a file on the glass at this point. To determine the boiling point it is not sufficient to plunge the bulb into boiling water, as water boils at slightly different temperatures in different kinds of vessels. It has been proved however that steam in contact with water possesses the same temperature no matter in what vessel the water is boiled, varying only with the pressure on the surface of the water; consequently steam at a certain pressure is taken, and the standard in this country is 30 inches of mercury.

From this we understand that the height of the barometer must be 30 inches when taking the observation, otherwise it will be necessary to make corrections from certain tables. Special precautions must be also used to prevent the temperature of the steam from being lowered by contact with the atmosphere.

The arrangement shown in figure is the usual one adopted to overcome these difficulties. It is composed of copper and its construction will be understood by reference to the figure. Its object is to isolate the steam from the surrounding atmosphere and to ascertain the pressure at which the observation is made.

The thermometer is placed in an aperture at the top (A fig. 2) closed with a well fitting cork. The apparatus is then placed over a small fire and the water made to boil; the steam generated passes up the central tube into the outer tube, and from thence escapes into the

atmosphere through the orifice (B). The stem of the thermometer is slowly drawn up through the cork until the level of the mercury appears, and a scratch is again made as before. The difference between the

Fig. 1.

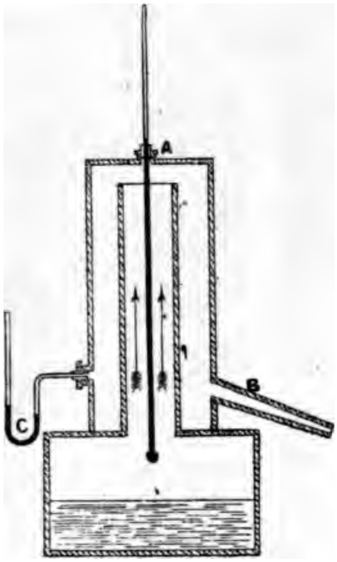


Fig. 2.

pressure of the atmosphere and the pressure inside the vessel is ascertained by means of a bent glass tube (C) containing mercury, one side of which is open to the atmosphere, and the other to the inside of the vessel. This difference is then added to the pressure of the atmosphere as given by the barometer, and, as before stated, corrections must be made if this total does not correspond to 30 inches of mercury.

The distance between the two marks thus found is next divided into a number of equal parts called degrees

Thermometer Scales.

There are three different methods of doing this, each receiving its name from the person who introduced it. These are respectively *Fahrenheit*, *Centrigrade* (*Celsius*), and *Réamur*. The two former methods e in constant use in England.

In *Fahrenheit's* scale the freezing point is marked as 32° and the boiling point as 212°, the distance between being divided into 180 divisions or degrees, and the zero being marked at 32° below freezing point. His

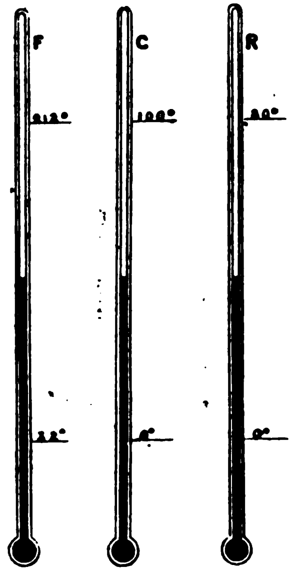


Fig. 3.

reason for choosing this point as zero was because he incorrectly imagined it to be the greatest cold attainable, and obtained it by mixing salt with snow.

In the *Centrigrade* scale the freezing point is marked 0° and the boiling point 100. The simplicity of this method is sufficient to account for these numbers being chosen.

Réamnr adopted 0° as the freezing point and 80° as the boiling point, and this style of numbering thermometers is in use principally on the Continent.

These divisions are continued above and below the fixed points, and temperatures below zero are indicated by means of a minus sign, thus — 1° C, — 5° C, &c.

Comparison of Scales.

It is sometimes requisite to convert the degrees of one scale to that of

another. The manner in which these are compared will be easily understood from the following:—

It is apparent from what has been previously stated that—

$$180^\circ\ F = 100\ C = 80\ R$$

$$\therefore 9\ F = 5\ C = 4\ R$$

hence (1) $F = \frac{9}{5} C$ (2) $F = \frac{9}{4} R$ (3) $C = \frac{5}{4} R$

From these three formulæ questions comparing different scales may be solved; but it must be remembered that 32 must be subtracted *before* changing F into C or R degrees, and in the converse problems must be added *after*.

This will be made more clear by a few examples:—

(1) A thermometer reads 77° F, what would the reading be in C degrees?

$$77 - 32 = 45$$

Now by formulæ $F = \frac{9}{5} C \therefore C = \frac{5}{9} F$

Then $45^\circ\ F =$
$45 \times \frac{5}{9} = \quad 25^\circ\ C$ Answer.

(2) Convert 30° C into F scale.

$$F = \frac{9}{5} C$$

$\because 30^\circ\ C = 30 \times \frac{9}{5} = 54 + 32 =$
$86^\circ\ F$ Answer.

(3) Convert 14° F into the R scale.

$$14 - 32 = -18$$

$$F = \frac{9}{4} R \therefore R = \frac{4}{9} F$$

Then $-18 \times \frac{4}{9} = -8\ R$ Answer.

(4) Convert 40 C in R scale.

$$C = \frac{5}{4} R \therefore R = \frac{4}{5} C$$

Then $40 \times \frac{4}{5} = 32^\circ\ R$ Answer.

EXPLOSIVES.

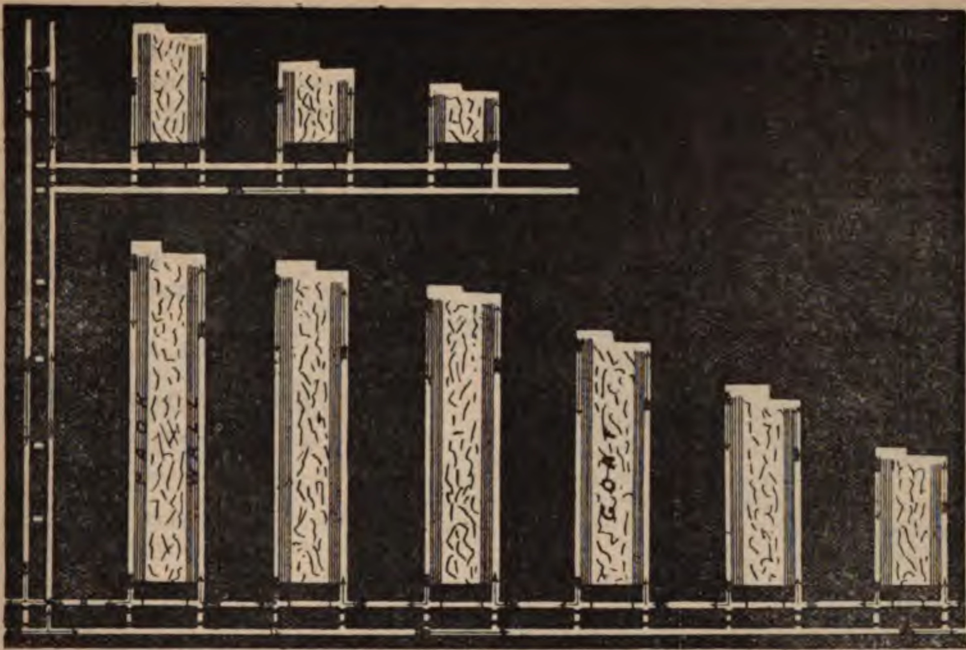
Chapter III.

GUN-COTTON consists of cotton waste immersed in nitric and sulphuric acids, after which it is freed from the adhering acids by washing. It is comparatively insensible to shocks, but should the shock be sufficient to explode it, only that part in contact with the object will explode. Frost takes no effect on it when dry, but it is safest to store it while wet, there being no need of drying it before firing. Bulk for bulk it is rather more than half as powerful as nitro-glycerine. It explodes with little or no smoke, and this is a great advantage to the miner, as he may return to his work immediately the shot is fired. It is insoluble in water, and is not affected by ordinary temperatures.

Tonite.—This explosive is a gun-cotton compound and consists of equal parts of the gun-cotton and nitrate of baryta, in some cases a small percentage of charcoal is added. The following advantages are claimed for it.—If by an accident it gets wet, it can be dried in a warm atmosphere without danger. Burns away slowly when ignited, but readily explodes when properly detonated. Is insensible to ordinary shocks; can be employed in wet holes and tamped with water. Does not produce any noxious gases from the explosion, which is of great consequence in closed works such as mines. Both Tonite and Gun-cotton are carried by the railway companies though they refuse to convey dynamites.

According to Mr. W. Fairley, a young man from seventeen to twenty years of age will push three tons one mile per day of twelve hours, along a level road with edge rails, and in tubs with ten-inch wheels, which is inclusive of the weight of the tubs both going in and out. This being six-tenths of the whole, it follows that the really useful work is less than one-and-a-half tons per mile.

Heavy Shipments of Coal.—A short time ago 29,936 tons of coal was sent from Tyne Dock, the largest quantity ever shipped in one day.



METHODS OF WORKING COAL.

DOUBLE STALL.

THE sketch shows the double stall method of working peculiar to South Wales. In this as in all other methods there are many modifications as will be seen by plan. The one we are considering commences by driving narrow levels from the pit in the ordinary way. The whole mine is divided into districts by driving similar strait places from the levels to the full rise at distances of several hundred yards from each pair; out of these again at a distance up of about 100 yards two other levels are started. Whilst these are being driven pairs of strait places are cut from the lower level into the solid coal left between the levels. The roadways of these pairs are about 20 yards apart, and after proceeding for about 8 or 10 yards each pair of roadways are connected by means of a cross-cut, and afterwards the coal is taken out in one face of 20 yards in extent. Tramways are left next the solid coal on each side of the excavation, the centre being filled with debris. The stalls proceeding from the bottom levels are not carried through to the levels above, but are stopped when a few yards away and thus a narrow pillar of coal is left. The distance between each set of stalls is also about 20 yards, and this pillar is worked down brow when the stalls on each side have reached the limit. When this pillar is worked down to about 10 yards off the level it is stopped, the remainder of the pillar being left for the support of the levels. Stalls are started in the higher level in a similar manner as shown in plan, and are carried on the next higher level, and thus they proceed until the boundary is reached. If the plan was continued on the right hand side, the next part to be shown would be upbrow strait places similar to those shown on the extreme left, and this would form another district. We shall illustrate other modifications of this method in future issues.

FOREST OF DEAN COALFIELD.

THIS small coalfield forms a more perfect basin than any other British coalfield. The seams everywhere dip towards the centre, and are bounded on all sides by the mountain limestone, on which they rest. Its area is about 34 sq. miles, and it contains 15 seams of coal, only 8 of which are workable.

The following is the order of succession:—

	FT.	IN.
Sandstone and shale with thin coal seams	830	0
(1) *Cow Delf*	0	8
Strata	91	10
(2) *Dog Delf*	1	2
Strata	46	9
(3) *Smith Coal*	2	6
Strata	34	6
(4) *Little Delf*	1	8
Strata	48	8
(5) *Park End High Delf*	3	7
Strata	56	0
(6) *Starkey Delf*	2	0
Strata	50	0
(7) *Rocky Delf*	1	9
Strata	77	6
(8) *Upper Churchway Delf*	1	11
Strata	34	0
(9) *Lower Churchway Delf*	1	6
Strata	150	0
(10) *Braizley Delf*	1	9
Strata	430	0
(11) *Yorkley Delf*	2	9
Strata	153	0
(12) *Whittington Delf*	2	6
Strata	137	0
(13) *Coleford High Delf*	5	0
Strata	124	0
(14) *Upper Trenchard Delf*	2	0
Strata	72	0
(15) *Lower Trenchard or Bottom Coal.*	1	4

The Coleford High Delf seam is remarkable for the horse which traverses through it. The horse with its branches appears to have been the bed of a river, which formerly cut its way through the vegetable matter when in a soft condition. The channel thus made was afterwards filled up with sand, stone, etc., and these interruptions in the seam of coal are a considerable loss to the colliery proprietors. It is about two miles in length and from 170 to 340 yards in breadth.

The mines are worked from the margin of the basin where they crop out towards the deep. The thickness of the coal measures are about 2,400 feet.

ANSWERS TO QUESTIONS

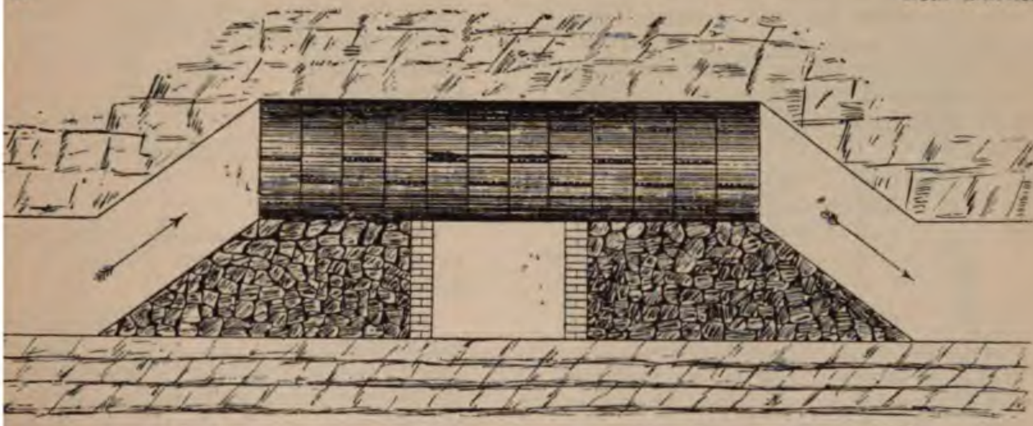
In No. 17.

Question 1.—Give sketch in section of a good air crossing. Discuss its construction and object.

Answer.—The position of an air crossing is the intersection of two roads. Here, the strata which forms the roof of the mine is taken out to a height of say eleven feet, and is gradually tapered off to the original height of the road, in the direction of that road which is to form the overcast as seen in the sketch. Next, the ends of the overcast roadway are built up to a height of five or six feet with bricks and mortar. Now, the most economical way of finishing its construction, but one which would in all probability be deranged by an explosion, is to place strong battens of wood across from wall to wall, and these are either morticed, or thin cleats of wood are nailed over the joints, after which they are plastered over with lime to ensure its being air-tight. The air crossing shewn in sketch is a much stronger one, though it cannot be erected as quickly, nor as cheaply. Its construction is similar to the one previously noted so far as the bricking and excavating are concerned, but instead of a covering of wood, an iron cylinder (which may be an old air receiver with its ends taken off), open at the ends, is fixed on the brickwork, and the wall is carried up and round so as to make it air-tight. The space behind the walls should be packed with debris, and to obtain the best form, the wall should be built semi-circular with the convex sides facing each other. If the cylinder be of fair thickness, and the walls built strong in the above manner, there would be little fear of it collapsing in case of an explosion. Air crossings of the above description are now becoming general at collieries where safety is considered before

nse. The object or an air crossing is to the foul air to cross the fresh air out coming in contact. It is customary se the overcast as the foul airway or n.

SAMUEL DAVIES,
Co-Op. Houses,
Mapplewell,
near Barnsley.



estion 2.—How does it happen that e the water feeders of a mine are iderable, very little fire-damp is met , and where little water is found much lamp may be expected ?

swer.—The water feeders being con- able indicate that the strata is open or as, and fire-damp being of a light re will naturally gravitate through these ings. Where much fire-damp exists little water is found, on account of the ness or compactness of the strata, which not admit of the exit of fire-damp or water to descend through it. Thus we see a shallow pit with much water and fire-damp, and a deep pit with little r and much fire-damp.

JOS. GRAHAM,
16, William Street,
Great Clifton,
Workington.

---

estion 3.—Whether do most explosions in the intake or return of a mine? reasons for your answer.

swer.—The most explosions occur in the e. The cause of this happening is that ntake is, in most cases, used as the main ge road, and here the air moves at a velocity, which causes it to be very dry; s a large quantity of coals are generally brought through these roads this causes e amount of very dry and fine dust to nulate on the sides and top of the place, his dust, mixed with a very small amount ht carburetted hydrogen or fire-damp, s an explosive mixture which will explode if by any cause it gets ignited. The above is the cause of explosions taking place more often in the intake than in any other place.

W. T. GARTON,
Helen's Nook,
Golborne.

Question 4.—How would you remove a pillar, 50 yards by 40 yards, in a mine whose inclination is 1 in 4, and is subject to creep?

Answer.—The best method, in our opinion, of working a pillar of the above description is, to commence on the lower side and take it out in one full breast, like longwall, having a face the width of the pillar. The roof should be supported as the face advances with props and chocks, the back ones being taken out as a fresh row is put in. A wagon road should be left up the centre, and be supported with pack walls, and the rails laid along the face of the workings.—Editor.

(None out of our numerous Competitors sent in the correct answer to the above question, most of them being in favour of taking it out in ribbons of several yards in width, but we are afraid that this system would not work in a pillar subject to the above conditions.)

Question 5.—If a fireman finds gas in a place when making an inspection, and removes it, does the Act require him to report its presence?

Answer.—Yes, for the Coal Mines Regulation Act, 1887, sec. 49, part of general rule No. 4, says:—"A report, specifying where noxious or inflammable gas (if any) was

found present and what defects (if any) in the roof or sides and what (if any) other source of danger *were* or *was* observed, shall be recorded without delay in a book to be kept at the mine for the purpose, and accessible to the workmen, and such report shall be signed by, and so far as the same does not consist of printed matter, shall be in the handwriting of the person who made the fnspection."

SAMUEL HOPE,
Mosley Common,
Boothstown,
near Manchester.

Question 6.—The rocks in the earth's crust are sometimes classified as stratified, unstratified, and metamorphic rocks. Mention some examples to prove clearly that you understand the meaning of the terms.

Answer.—The miscellaneous debris borne down a river will arrange itself in layers along the bottom, the shingle and gravel falling to the bottom first, next the fine sand, and lastly the mud. In this way, in course of time, a series of layers will be formed. These layers are known as strata: hence all rocks arranged in layers, that is arising from sediment in water, are termed aqueous, sedimentary, or stratified. Aqueous refers to the agency by which rocks have been produced; sedimentary, to the mode in which they have been formed or arranged. On the other hand, when we examine the rocky matter ejected from volcanos we find no such lines of deposit. In general, they break through the stratified rocks or spread over them in mountain massesof no particular form. Referring to their origin, they are spoken of as igneous, and to the way in which they have been produced (that is) eruptive, while in contradistinction to the stratified rocks they are termed the unstratified: the one depending on the operations of water, and the other resulting from the operation of fire. The metamorphic system embraces the gneiss, mica-schist, and clay slate groups. The name metamorphic refers to its mineral characteristics, and implies that the original structure and texture of its rocks have undergone some internal change or metamorphosis. These rocks are all less or more crystalline, their lines of stratification are often obliterated, or but faintly perceptible, and their whole aspect is very different from what is usually ascribed to rocks originally deposited in water. This change may have been brought about by the long-continued influences of heat and pressure, or it may be the result of some peculiar chemical actions, combined with pressure, amongst the particles of which these rocks are composed. Examples of stratified rocks are Sandstone, Shales, and Coal; of unstratified rocks, Granite and Basalt; of metamorphic, Crystalline and Limestone.

W. T. GARTON,
Helen's Nook,
Golborne.

Question 7.—Why are dip workings easier to ventilate than those having a rising inclination?

Answer.—The reason dip workings are easier to ventilate than those to the rise is that as the cold air is conducted to the dip workings it is gradually warmed by the heat of the mine, and by the time it reaches the return airway it is much warmer, and therefore lighter, than the air in the intake. It will thus be seen that the warm air has a tendency to rise and be displaced by the colder air from the intake, so that the difference in temperature assists the rising column, and thus the ventilation. In the rise working it is just the reverse, as the warm air has to be drawn down from the workings, and being lighter than the intake, it does not balance it, and thereby impedes the ventilation.

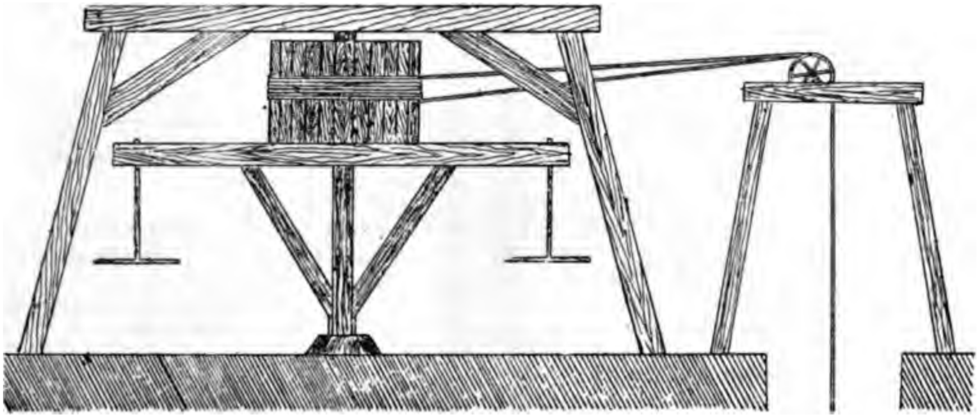
ERNEST POWELL,
Kaye Street,
Heckmondwike.

Question 8.—Describe with sketch the construction and principle of the horse whim, and compare its useful effect with other winding appliances?

Answer.—The horse whim or gin is constructed as follows:—The span beam 36 feet long and 10 inches square, made of Norway pine or fir, supported by legs, and strengthened by stays and iron strapping plates. The axle or king-post is generally of oak, 12 inches diameter, from 12 to 14 feet long secured at the ends with hoops of iron, and each end has an iron centre attached; the top centre works in a socket of iron fixed to the span beam, and the bottom centre works in a block of stone. The driving beam is fixed about six feet from the lower end of the axle, about 30 feet in length, strengthened by stays, and a yoke is attached to each end. Above the driving beam arms are morticed into the axle upon which wooden segments are nailed, and upon these segments are nailed the planks which form the drum or barrel, which

is about 10 feet diameter. The machine described is a very efficient appliance for winding, up to the depth of 50 or 60 fathoms. Above this depth I would prefer a steam engine.

JAMES BURROWS,
103, Chapel Street,
Dalton-in-Furness.



Question 9.—A sinking pit is 300 yards deep, and the average diameter of the shaft 15 feet, the water is standing 120 yards up the shaft, and the shaft feeders are 260 gallons per minute. In what time can the shaft be pumped dry with a 14in. set, 8ft. stroke, and making 10 strokes a minute?

Answer.—120 yards × 3 = 360 feet = depth of water in shaft. $360 \times 15^2 \times \cdot 7854 = 63617 \cdot 4$ = number of cubic feet of water in shaft. Now, one cubic foot of water = 6·25 gallons, therefore $63617 \cdot 4 \times 6 \cdot 25 = 397608 \cdot 75$ = number of gallons in shaft. Again the contents of pipes or cylinders may be found by squaring diameter in inches and multiplying by ·034, and this equals number of gallons for each foot in depth. Therefore the pump will lift $12^2 \times \cdot 034 \times 8 \times 10 = 533 \cdot 12$ gallons per minute. The number of gallons in the shaft divided by the number lifted by the pump in one minute, minus the number of gallons running in per minute (these being deducted previous to the division), will equal the number of minutes necessary for the emptying of the shaft. Thus $\frac{397608 \cdot 75}{533 \cdot 12 - 260} = \frac{397608 \cdot 75}{273 \cdot 12} = 1455$ or 24 hours 15 minutes.

GEORGE DAYKIN,
24, High Gurney Villa,
Bishop Auckland.

(The following Competitors also sent the correct answer:—Joseph Wallwork, Hugh McIntyre, Neil Freeland, and James Burrows.)

Question 10.—What are the chief dangers sinkers are liable to, and how would you proceed to avoid them?

Answer.—Dangers liable to sinkers may be enumerated as follows:—1st.—Dangers from falling stones. This may be avoided by the use of a "penthouse," or by the master sinker seeing that no loose debris adheres to the bottom of the kibble, and steadying the kibble before it leaves the bottom. 2nd.—Danger of the men being injured through shot-firing, by the use of single engines. This danger may be avoided by the use of a double engine, as there is no danger of this class of engine standing on the dead centres, and thus imperilling the sinker's life. All shots should be fired by electricity. 3rd.—Dangers arising from fire-damp when the sinking nears a coal seam. Avoided by the use of safety lamps in making the inspection after shots have been fired. 4th.—Dangers from "stythe" or black-damp, which may issue from some old goaf, or may exist as a resultant gas from the explosion of gunpowder. If this gas is found it may be guarded against by good ventilation, and removed before the sinking is proceeded with by means of pipes reaching from the surface to the bottom, and a small fan connected to them. 5th.—Dangers from giving way of the strata. This danger may be avoided by removing loose stones when the sides of the shaft are being examined (which is done before the sinkers descend to their work), and by sufficient cribbing and walling being put in where required. 6th.—Dangers from bursting of tubbing. Avoided by using tubbing of sufficient strength, and provided with pass-pipes to allow gases to escape from behind the tubbing. 7th.—Dangers from the breaking of ropes and chains. Avoided by having the

ropes and chains of the best material possible, and allowing a sufficient factor of safety in their working.

THOMAS BEST,
Railway Street,
Tow Law, Co. Durham.

Question 11.—Are any advantages gained by splitting air, if so, what are they?

Answer.—The advantages of splitting the main air-currents of a mine, and supplying each district with fresh air are:—1st.—Less ventilating power is required to produce the same quantity of air than would be required if the air was conducted in one unbroken current round the whole of the workings of a mine; the circuit that the air travels is réduced in length, and the velocity is not so great. 2nd.—The men have purer air to breathe, as before the introduction of splitting, in many cases, it was so laden with deleterious gases as to be totally unfit for the support of a healthy person. 3rd.—In splitting the air current the ventilation is not so apt to be deranged as in conducting it in one current, less doors are required, and if the ventilation be in one current and a door gets damaged, the whole of the pit's ventilation is affected, whereas should anything occur in one district so as to dangerously derange the ventilation, the rest of the districts are seldom affected. 4th.—Should an explosion occur, its effects are comparatively local to a district. 5th.—Each district gets a separate supply of fresh air, and advantage is taken of the C.M.R.A. for blasting, where each district is treated as a separate mine.

ARCHIBALD GOURLAY,
High Sourlie-by-Irvine,
Ayrshire.

Question 12.—What size hauling engine would you require to haul 100 tons per hour up an incline, 800 yards long, rising 1 in 5. Steam pressure in boilers, 60lbs. per sq. in.?

Answer.—Assume average speed of gang to be six miles an hour.

6 miles = 31,680 feet
800 yards = 2,400 feet

Or the double distance (*i.e.*, there and back) = 4,800 feet. If 31,680 feet require one hour 4,800 feet will take

$$\frac{4{,}800 \times 60}{31{,}680} = 9{\cdot}9 \text{ minutes, say } 10.$$

Allow 5 minutes for changing tubs, etc., = 15 minutes for double journey, or 4 gangs per hour, each hauling 25 tons of coal. The tubs necessary to hold the mineral will weigh $\frac{2}{5}$ths more.

$\frac{2}{5}$ths of 25 = 10 + 25 = 35 tons gross load.

Inclination = 1 in 5 $\therefore \frac{35}{5}$ = 7 tons nett load.

A rope of seven pounds per yard would be applicable for such a load.

800 yards at 7 lbs. per yard = 5,600 lbs.

$$\text{Nett load} = \frac{5600}{5} = 1{,}120 \text{ lbs.}$$

Nett load of rope = 1,120 lbs.
Do. coal and tubs = 15,680 lbs. (tons).

16,800 Total nett load.

Add to this $\frac{1}{28}$ of gross load for friction.

Gross load of coal and tubs = 35 tons or ... ... 78,400 lbs.
Gross load of rope = 5,600 lbs.

84,000 Total gross load.

$\frac{1}{28} \times 84{,}000 = 3{,}000$ allowed for friction.

Nett load of rope, tubs, and coal = 16,800
Allowed for friction 3,000

19,800 lbs.

Take diameter of drum as 5 feet = 15·75 feet circumference.

Then 19,800 × 15·75 = 311,850 lbs. moment of load.

The power is the pressure on the piston, and its leverage is the double stroke of the piston. Assume the stroke of piston as 5 feet, and this can be altered afterwards, if it does not work out proportionate to the diameter of the cylinder.

Double stroke = 10 feet.

Effective pressure on piston will be about $\frac{2}{3}$rds that at boiler.

$\frac{2}{3}$ of 60 = 40 lbs effective pressure.

$$\text{Then } \frac{311{,}850}{10 \times 40} = 779{\cdot}625 = \text{theoretical area of piston.}$$

Add $\frac{1}{2}$ of this for general exigences.

779·625 = 780 nearly.

$$780 + \frac{780}{2} = 1{,}170 \text{ sq. inches for one cylinder}$$

or, using a pair of cylinders, $\frac{1{,}170}{2} = 585$ sq. inches for each cylinder.

$$\sqrt{\frac{585}{\cdot 7854}} = 27{\cdot}5 \text{ nearly.}$$

I should use a pair of engines, cylinders 5-feet stroke, 27½ inches diameter, working direct. Or, to give margin for surplus power, a 30-inch cylinder, 5-feet stroke. The speed of the piston would be well within the limit allowed.—Editor.

(The nearest answer to this question was sent by JAMES WEIR, 18, Sunnyside Terrace, Coatbridge, N.B., to whom the prize will be awarded.)

PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions subject to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by August 19th, 1893.

Question 1. (E.)—How is coal found, and what are the terms used to describe—(*a*) The character of the deposit. (*b*) The interruptions and disturbances to which they may have been subjected?

Question 2. (E.)—How would you sharpen and temper the bit of a borer for boring by hand in rock? What shape and dimensions would you prefer?

Question 3. (E.)—What is a coal seam?

Question 4. (A.)—What is meant by the terms stratified, unconformable, anticlinal, synclinal, and roll?

Question 5. (A.)—How many methods of ventilating a mine are you acquainted with? Which is the best, and state reasons for your answer?

Question 6. (H.)—How is coal handled between its arrival at bank, and its discharge into the railway wagons?

Question 7. (H.)—What methods of drawing minerals have been proposed, other than winding drums? Give any sketch you may consider necessary to illustrate your answer.

Question 8. (H.)—Give an account of the mines on the great flat lode south of Redruth and Cambourne.

Question 9. (M.)—What are the conditions to be observed as prescribed by the Coal Mines Regulation Act of 1887, for shot-firing in "fiery" and "non-fiery" mines? (The exact words of the Act are not required).

Question 10. (M.)—Give size of an engine you would use to bank 600 tons of coal in 10 hours, up a drift 430 yards long, rising 1 in 2, the engine drawing 4 trams each journey. Each tram holds 34½ cwt., and the weight of a tram is 15½ cwt., pressure of steam on engine 55lbs. Men are raised and lowered down the above drift. Give size and quality of rope you should use, what sort of attainment you would have between the trams, and how you would attach the rope to the trams.

Question 11. (M.)—Give a brief description of the colliery at which you are now engaged, and state the mode of working, and distance between stalls, etc.

Question 12. (M.)—State the advantages and disadvantages of electric lighting and signalling underground.

The letters E. A. H. and M. in front of the questions are to denote to which class the question belongs, whether Elementary, Advanced, Honours, or Managers.

CORRESPONDENCE.

Heworth Colliery,
Felling, R.S.O.,
Durham.

Dear Sir,

This last number of your Journal is a considerable improvement, I am sure it deserves the most unbounded success, and I will endeavour to obtain new readers, as I consider it my duty to forward the interest of such a valuable and cheap Journal.

Wishing you every success,

I am, respectfully yours,
THOMAS WALLETT,

P.S.—My attention nas been drawn to the fine sketches which have recently appeared.
T.W.

Railway Street, Tow Law,
July 18th, 1893.

Sir,

Allow me to congratulate you on the marked improvement of last issue of "Mining" (No. 17). It is the best mining paper that I have seen. I recommend and introduce it to my friends. Wishing you and the Journal every success,

I am, yours very respectfully,
THOS. BEST.

ANSWERS TO CORRESPONDENTS.

E.P.—We will be glad at any time to receive intimation from our readers pointing out any mistake which, despite our utmost efforts, may be inadvertently published. But the calculation you refer to is correct. The area of the cylinder is obtained by multiplying the radius squared by 3·1416; not the diameter as you state. In reference to the second part, it is usual to calculate the power of one cylinder only, as one may be powerless at dead centre when the load requires starting.

H. GRAY (Durham).—You had better refer to the Hardy Patent Pick Co., Sheffield, for what you require.

NOTICES.

"MINING" UNDER NEW MANAGEMENT.

As many of our readers have already perceived the last few issues of this Journal have heen conducted under new management. Numerous alterations have been made both as to quality and quantity, and althongh they increase the cost of production considerably, we are pleased to see that our efforts are being suitably appreciated. We have received numerous letters from readers (a few of which we publish) congratulating us on the marked improvement. Again, the demand for recent issues has increased wonderfully, and the competition in answering questions is more keenly contested. We may add here, for the benefit of those competitors who have complained that the time allowed for answering questions is insufficient, that we intend to extend the time from Thursday to Saturday. We are sorry to say that we cannot possibly allow more time than this. The numerous answers to be examined, the blocks to be prepared, and the time required by the printers previous to publication, makes it necessary to have all answers in within the specified time.

Now, although we are satisfied that our efforts to improve the quality of this paper have not been in vain, we will always be pleased to hear suggestions from any of our readers, by which we may make it more valuable to the mining community. We will give each suggestion the most careful consideration, and if we conclude that it would in any way improve the paper, we would at once take steps to give it a fair trial.

We are in receipt of a letter from a well-wisher, suggesting an increase in the number of pages and a corresponding increase in the price. In the first instance the suggestion is good, but we do not consider it would be wise to raise the price, and we find it utterly impossible to enlarge the Journal at the present price. We are, however, entirely in the hands of our readers. All we ask is, if the paper satisfies you to recommend it to all your friends. By doing so you will give us a chance to enlarge it and keep it at the same price, as it is only by increasing the circulation we may ever hope to attain that end.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

Cheques and P.O.O. to be made payable to STROWGER AND SON, Wigan.

Printed and Published by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

MINING

A Journal devoted to the interests of Mining.

No. 20. Vol. I. AUGUST 24, 1893. FORTNIGHTLY ONE PENNY.

GENERAL INFORMATION.

SHOT-DRILLING.

In the shot process of drilling through rock, steel shot are poured inside the drill pipe into a ring or channel made in the rock by a few revolutions of the pipe. The pipe bears on this ring of shot, and when it is revolved it causes the shot to revolve also, and cut the channel in the rock deeper, as boring large holes through hard rock by means of diamonds (which are now costing three or four times as much as they did a few years ago) is very expensive work; the new process of drilling by means of steel shot, will, it is expected, be used in many cases instead of the diamond tube. A test boring, eight inches diameter and 390 feet deep, was recently put down by the National Boring and Drilling Company, which owns the process.

A SIMPLE BAROMETER.

A simple, but effective barometer, it is stated, can be made by filling a common wide-mouthed pickle bottle within three inches from the top with water, then taking an ordinary Florence oil flask, and having removed the straw covering and washed it thoroughly, plunging the neck of the flask as far as it will go in o the pickle bottle, you have thus a complete barometer. In fine weather the water will rise in the neck of the flask, higher than the mouth of the pickle bottle; in wet and windy weather it will fall to within an inch of the mouth of the flask. Before a heavy gale of wind, at least eight hours before the gale reached its height, the water has, it is said, been seen to leave the flask altogether.

A CONVENIENT SIZE OF PAPER.

Buyers of machinery, etc., in America, are prevailing on publishers of catalogues to adopt one size of paper, namely, six inches by nine (almost the size of our journal), for convenience in handling and shelving. By this means purchasers of large quantities of machinery can have the several catalogues bound, and the adoption of this size will ensure more attention for this reason.

ALUMINUM FOR MINING PURPOSES.

It is stated that the engineers of the North of France are studying the application of aluminum to the manufacture of cages, cables, &c. The difference in weight between aluminum and iron or steel is considerable, and consequently the use of the former would increase the load capacity; on the other hand, the continuous lowering of the price of the metal renders its use possible.

THE BURNING OF ANTHRACITE IN OPEN GRATES.

A Mr. Payne has recently patented an appliance for burning anthracite in open grates. The difficulty to be overcome is the insufficient draught which is produced under ordinary circumstances. This invention, which is known as the "Climax," is claimed to be the only apparatus of its kind yet produced which requires no special means of fixing, and is applicable to all descriptions of grates. By its employment a large and efficient draught is produced for the proper combustion of anthracite coal. In applying the contrivance it is only required to be placed upright or against the back of the grate, and the fire is lighted in the ordinary way. When the apparatus is thoroughly hot a valve is opened, and a strong draught is thereby induced. It is made of cast metal or fire-clay, and is of simple and cheap construction. From the description, it appears to us to possess the defect common to contrivances previously produced for the same object, namely, requiring a fire to be commenced of ordinary coal, or the burning of numerous chips before the appliance is available to produce the necessary draught.

MEMORANDA.

The area of a square is = the square of its side.

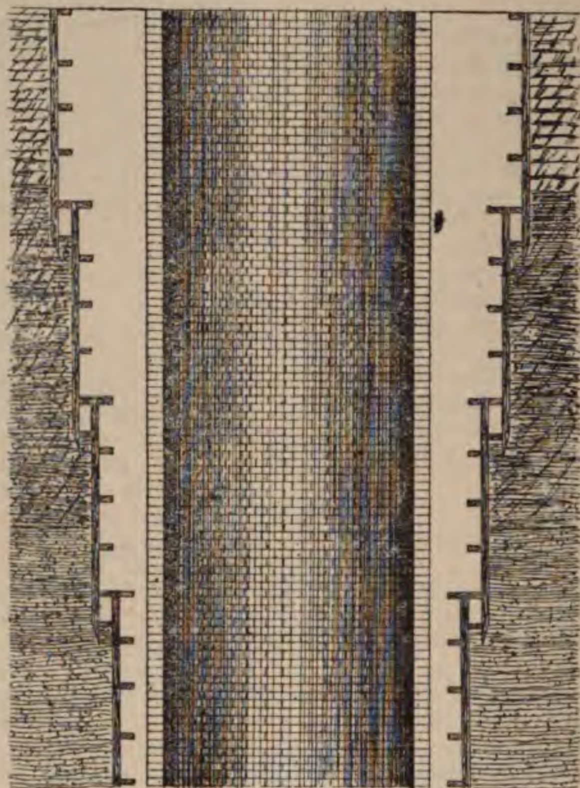
The area of a parallelogram is = the product of its length and breadth.

The area of a triangle is = the base × half the perpendicular falling from the opposite angle upon the base.

SINKING.

Chapter II.

SOMETIMES the strata to be passed through near the surface consists of quick-sand or wet and loose gravel which cannot be sunk through in the ordinary way, and these present many difficulties, and are the source of great expense. Several methods have been successfully adopted to pass through the loose sand, the commonest of which is that known as pile driving. This method is shown in figure and will be easily understood with the aid of a brief description. Piles of timber fifteen feet long, six inches broad, and three inches thick, pointed at one end and shod with a band of iron at the other, are driven vertically downward, all round the circumference of the shaft, but instead of its diameter being the same as the proposed shaft, it may be twice as great (the size being governed by the depth of the quick-sand.) The reason for this will be apparent from sketch, but will be better understood as we proceed with description. The piles being driven down, cribs* are placed at distances of a few feet inside the piles as the material is excavated, to keep the piles in position and prevent them from crushing in. The cribs are of timber, six inches deep, so that for each set of cribs and piling the shaft is reduced in diameter eighteen inches. At twelve feet deep two cribs are laid one inside the other, with a space of three inches between them, that is the diameter of one is eighteen inches less than the diameter of the other.



A fresh course of piles are then driven between these two cribs, and the ground is excavated, and cribs fixed in as before. Another row of piles are again driven in, twelve feet down the last course, and the same operation again performed. This method of procedure is continued until the solid ground is reached, after which the bricking is carried up as expeditiously as circumstances will allow, the space between the brickwork and the piles being packed up with clay. Another method of pile-driving is to commence with a circle very little larger in diameter than the proposed shaft, then instead of driving the piles vertically downward they are driven outward away from the shaft. The material inside is excavated and the pressure on the back of the piles forces them towards the shaft at the bottom, but they are only allowed to be forced into a

* See No. 18, Vol. 1, of "Mining."

position such that the diameter at the bottom is eighteen inches more than at the top, and are kept in their place by means of cribs. Piles are again driven in the same way, and by this means the shaft is retained at the one size. The piles do not fit close to each other at the bottom as they must fill a larger circle, and to prevent the loose strata from running into the excavation the interstices are packed with straw or some such material. This method is not so expensive as the one previously described, but it is not nearly so efficient.

(*To be continued.*)

GEOLOGY.

The most important Substances in the Earth's Crust.

THE Earth's Crust is the name used to denote the cool, solid outer parts of the globe.

Oxygen is by far the most important compound of the earth's crust, being about 48 per cent. of the whole structure. It seems strange at first sight that a gas, such as Oxygen, should make up by weight almost half of the known portion of our earth, but such is the case.

Silicon comes next to Oxygen in frequency of occurrence. It is never found free, its most common form is Silica, which it forms in combination with O, in the proportion of one atom of Silicon to two atoms of Oxygen. It also occurs largely in the Mineral *Quartz*. It is present in varying quantities in most mineral waters, and is also secreted by both animals and plants. Silicon is very hard, which causes it to be extremely useful in cementing the materials composing various rocks together, and enables them to resist better the decomposing effects of air and water.

Carbon comes after Silicon in point of importance. Its most pure form is the Diamond, and also Black Graphite; a less pure is Coal and Charcoal. It is the base of all plants and animals, and forms a connecting link between the animal and vegetable worlds. In combination with Oxygen, it forms Carbonic Acid Gas, which is caused by the breathing of animals and combustion. It is inhaled by plants in the presence of sunshine, the Carbon being retained, and the Oxygen exhaled in a nearly pure state.

Sulphur ranks after Carbon. It is found chiefly in volcanic vent-holes, either as pale yellow crystals or shapeless masses and grains. It is seldom found pure, usually in combination with some metal and Oxygen, or with a metal alone. In the former case the combination is called a sulphate, and in the latter a sulphide.

Hydrogen comes next, being the next gas to Oxygen. It has been found in a free state at active volcanic vents, but it is usually found in combination with Oxygen forming water. It also enters into the combination of plant and animal substances, and forms with Carbon what are known as *Hydro-carbons*, of which mineral oil and coal-gas are examples. It is also found combined with sulphur, forming the gas Sulphuretted Hydrogen, and also with chlorine, forming Hydrochloric Acid.

Chlorine is a gas of a greenish-yellow colour, but, except at volcanic vents, it does not occur free in nature. In combination with Potassium, Sodium, and Magnesium, it forms most of the salts in sea-water. Sodium

chloride is the chief of these salts, or common salt.

Phosphorus does not occur free; so strong is its affinity for Oxygen, that it rapidly combines with it, and sometimes even melts and takes fire. It is usually found combined with Oxygen and Calcium, forming what is commonly known as *Phosphate of Lime.* It occurs in both seawater and fresh water, and also in soil and plants, especially in their seed and fruits. The bones of animals consist almost entirely of Phosphate of Lime.

HEAT.—By Calor.

Chapter III.

Maximum and Minimum Thermometers.

THE ordinary thermometers described in my last chapter, simply give the temperature at the particular time of observation, and as it is frequently requisite to know the greatest and least temperature reached during the day or night, an instrument has been invented to obviate the necessity of perpetually watching. These thermometers record the highest and lowest temperature reached since last adjusted. This instrument is known as the maximum and minimum thermometer, and is illustrated by Fig 4. The thermometers are fixed on a plate of glass and suspended from a nail horizontally as shown in figure. The top one is the maximum and the bottom the minimum thermometer. The maximum thermometer contains mercury, and at the end of the mercury is placed a small piece of iron wire (shown at A). This wire is pushed along the tube by the mercury as the temperature increases, but when the temperature decreases and the mercury retreats, the wire remains stationary at that point in the tube to which the mercury had carried it, thus registering the highest temperature reached from the last adjustment. The number of degrees may be read from the scale marked on the glass, care must be taken not to read them from the centre of the wire but from the end nearest the mercury. The minimum thermometer contains coloured alcohol instead of mercury, and the iron wire is replaced by a glass tube (B), and this serves to indicate the lowest temperature attained. We will suppose the glass tube is at the extremity of the alcohol. When the temperature decreases the fluid contracts and draws the small tube with it by the attraction of cohesion; on a change in the temperature the alcohol rises round and through the tube without interfering with the position of the tube; thus the lowest temperature is registered, reading in

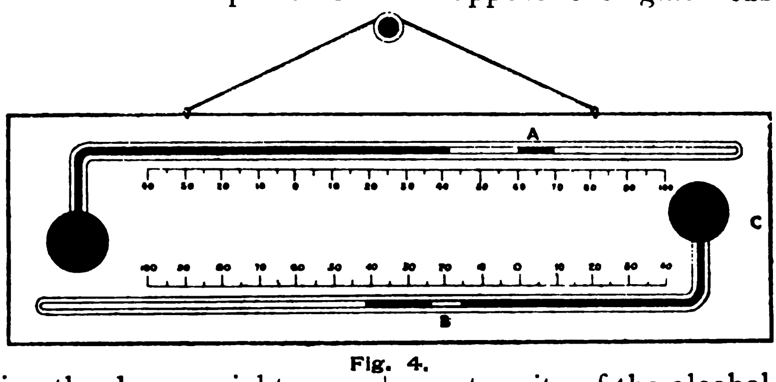


Fig. 4.

this case from the furthest end from the bulb. To prepare this instrument for an observation, the plate of glass must be held vertical with the C end uppermost, by which means the indices A and B will move to the end of the columns of mercury and alcohol, and by suspending the plate in an horizontal position the instrument is ready to record the temperatures.

(To be continued.)

EXPLOSIVES.

Chapter IV.

Flameless Explosives.

MANY comparatively flameless explosives have recently been introduced consequent on the numerous fatal accidents in coal mines resulting from the explosion of fire-damp in coaldust caused by the flame emitted by the firing of the charge. The first invention, having for its object the extinction of the flame, was the "water cartridge. The explosive charge was entirely surrounded by water, and any flame produced by the explosion was quenched almost instantaneously. Following this was the introduction of solid substances mixed with the explosive, which possessed fire-quenching properties. Of this class Roburite is perhaps the best known and most generally used.

Roburite is the invention of a German chemist, named Dr. Carl Roth, and consists of chlorinated dinitro benzol mixed with ammonia nitrate. Neither of the substances mixed together to form this compound are explosive separate; yet the power of the explosive is nine times that of gunpowder. Dr. Roth's claims for his explosive are:—

(1) That the two compounds are harmless, and inert separately, so that they can be stored and transported without any restriction whatever. (2) That even when mixed or ground up together in an ordinary coffee, cement, or flour mill, the mixture is perfectly safe to handle and use, as neither percussion, friction, nor the application of an ignited or heated body will cause it to explode; this can only be effected by using a detonator charged with fulminate of mercury. (3) Tha when detonated Roburite produces neither spark nor flame, and will not, therefore, ignite fire-damp or coaldust in mines. This was decided by the trials of the Imperial German Commission upon Accidents in Mines, and that in consequence this explosive is now employed in the coal mining regions of Germany as affording absolute safety to the men employed. (4) The amount of noxious gases produced by this explosion is so infinitesimal, that for this reason alone it is superior to other explosives in common use for mining work. (5) Roburite is not subject to deterioration through climatic variations of temperature. It should be kept dry, but if it becomes damp its strength can be safely restored by drying. The above claims are based on experiments conducted at Chatham, one of which was the thrusting of a red-hot iron from a portable forge into the Roburite, which only caused slow combustion and crepitation locally, and this ceased when the iron was withdrawn. When a quantity was put on the forge fire it merely burnt away like an ordinary combustible. Another test was the grinding of the substance through a small handmill, and afterwards striking direct and glancing blows

with heavy hammers upon it without exploding. Mr. Hilton, in a paper read before the Manchester GeologicalSociety,gives the following instructions regarding Roburite :—(1) The drill-hole should only be a trifle larger than the diameter of a cartridge, and is more suitable when machine-drilled. (2) Open one end of the cartridge, bore a hole down the centre of it (with a wooden peg), then insert the detonator well into the middle of the cartridge, and next tie the covering of the cartridge point to the fuse. (3) In tamping be careful to use dry material, and to ram the hole very lightly for the first three or four inches, so as not to displace the detonator or compress the Roburite, afterwards tamp finally for not less than a foot with clay or damp borings from the drill-hole. This rule is most important, as the safety of the explosive depends on the tamping. (4) Fire the detonator with an electric fuse where fire-damp is given off or coal-dust is present. (5) Store Roburite in a dry place, and if the hole is wet fire the charge as quickly as possible after it has been placed in the hole. (6) If the charge misses fire disconnect the cable from the battery and wait ten minutes before going to it, for although there has not been a single case of hanging fire with me in over 3,500 shots, yet I have heard of an accident happening through a shot hanging fire for a few minutes. It is supposed that the paper at the end of the electric fuse inserted in the detonator smouldered for a short time, and fired the fulminate of mercury.

(*To be continued*).

If all the power that coal possesses could be converted into mechanical work, 1lb. would be sufficient to perform work equal to four-horse power for an hour. But steam engines generally use twelve times this amount

LANCASHIRE COALFIE

THE Coalfield generally kr under this name occupies greater part of the southern porti the County of Lancashire, extends into parts of the adjoi Counties of Cheshire, Derbys and Yorkshire. It is about 40 r long, with an average width o miles and an area of about 217 sq miles. It is terminated on the by a tremendous downfault w throws down the coal seams tow the sea, and brings in the New Sandstone. It ranges thr Eccleston, Lathom, Bickerst Knowsley Park, and Huyton. the north it is bounded by Mills Grit, which runs to a consider elevation. On the south they under the newer formations of Trias and Permian period; on south-east it crosses the Mersey peculiar character of this coalfie that the sedimentary strata thic towards the north. For exan two mines, namely the Pembe 2-feet (which is not worked by it and the Pemberton 4-feet are yards apart at Wigan, while Bamfurlong, a few miles fur south, they run so closely toge that a parting is scarcely percept and they are worked under the n of the Bickershaw 7-feet mine. most valuable seam of the coal is the cannel mine which, howe unfortunately thins out in e direction with Wigan as a cei The following is the order succession of the coal seams :—

	FT
Four-foot Coal of Red Rock	4
Ince Yard	3
Ince 4-feet	3
Ince 7-feet	7
Furnace Mine	4
Pemberton 5-feet	5
Pemberton 4-feet	4

Wigan 5-feet	4	6
Wigan 4-feet	4	0
Wigan 9-feet	9	0
Cannel	1 to 3	0
King Coal	3	10
Yard Mine	3	0
Bone Coal	2	3
Smith Coal (Rushy Park)	3	6
Arley	4	0

The Coal Measures are divided into belts by large faults running. parallel to each other in a N.N.W. direction. The GREAT UP-HOLLAND FAULT has a throw of 650 yards east, and brings up the Lower Coal Measures between Rainford and Wigan. The SHEVINGTON FAULT, down east, 450 yards; the GREAT HAIGH FAULT, downthrow west, 600 yards; and the CANNEL FAULT of Ince, of about 150 yards, are the principal faults in the Wigan district. LATHOM FAULT, downthrow 500 yds., diminishes northward. GIANT'S HALL FAULT, downthrow west, 600 yards, ranges through Abram and Standish. IRWELL VALLEY FAULT, near Manchester, has a downthrow of 1,000 yards, and brings in the New Red Sandstone.

PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by September 2nd, 1893.

Question 1. (E.)—How do you account for the fact of coal seams being at present below the sea?

Question 2. (E.)—How have the fossils of animals and plant remains, footprints, etc., been preserved through the long ages which have passed since their occurrence?

Question 3. (E.)—How is water raised from a deep mine without pumps?

Question 4. (A.) — What changes are observed in coal seams near faults or troubles, and how are workings laid out in faulty ground?

Question 5. (A).—Describe with sketches the principle of construction of the plunger pump?

Question 6. (A.)—What are the special advantages and disadvantages of fixing steam engines underground?

Question 7. (H.)— What are the most approved methods of washing coal slack?

Question 8. (H.)—What methods have been employed to determine the deviation of boreholes from the vertical?

Question 9. (M.)—Describe and illustrate by sketches and dimensions, the way you would lay out the roads at the bottom of the drawing shaft of a colliery when the quantity required to be drawn is 600 tons of ten hours?

Question 10. (M.)—Describe fully what arrangement of signals you would adopt for winding from two different levels or stages in a shaft, as occasion may require throughout the shift?

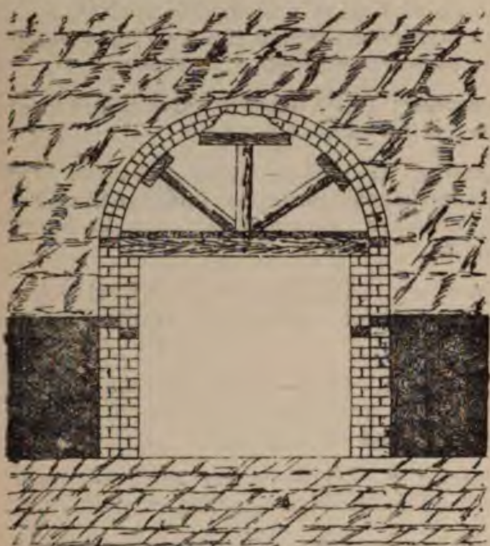
Question 11. (M.)—Many colliers are injured or killed by falls. State what you have noticed to be the principal causes of such accidents, and how they may be prevented?

Question 12. (M.)—Can you suggest any alteration or addition to the Coal Mines Regulation Act for the proper and safe working of a colliery, and state in as brief a manner as possible the nature of such suggestions?

The letters E. A. H. and M. in front of the questions are to denote to which class the question belongs, whether Elementary, Advanced, Honours, or Managers.

ANSWERS TO QUESTIONS
In No. 18.

Question 1. (M.)—The crown of the arch at the pit eye is crushing, through the removal of the pillars near the shaft. Explain with the aid of a sketch, how you would proceed to remedy this defect.



Answer.—It would be useless with the above conditions to build a new arch immediately under the old one, as that too would be crushed in a short time, and if metal girders were used they would in all probability snap off suddenly under the enormous pressure. The best method to adopt, in our opinion, is that shown in sketch. Brick walls are built inside the old brickwork to the top of the straight walls, baulks of timber a foot square are then fixed about two feet apart, and planks several inches thick are placed on these. The arch is supported by props in the manner shown. If after a time the strata settles and the height is thought to be insufficient, the timber can be taken out and a brick arch built from the two side walls.—EDITOR.

(Prize awarded to JOHN LAVERICK, Eppleton Colliery, Helton-le-Hole, R.S.O.)

Question 2. (E.)—Why is it not a proof of good ventilation in a mine to have a very good current of air in a small place?

Answer.—The reason why it is not a proof of good ventilation, is, because quantity is one thing and quality another. We may have, with a sudden fall of the barometer, a good current ventilating quantity, but that current may be so charged with carbonic acid gas or stythe as to extinguish all lights and almost suffocate the workmen. Again the velocity of the current increases according as the area of the roads decrease. Thus we see that we may have a rapid current in a small or narrow place, yet not have a sufficient quantity of air to ventilate the mine properly.

JOHN STALKER,
Dipton,
Lintz Green, R.S.O.

Question 3. (E.)—What is an adit level? Give particulars of any remarkable adits of which you have heard, or with which you may be acquainted.

Answer.—An adit is the water level of a mine. When a level opens to the surface at the side of the valley, it forms what is termed an adit or day level, and most metal mines have at least one for the purpose of drainage. When the mines are situated near the deep ravines of mountainous countries a succession of adits may be driven in, one below the other so as to prove the mine and drain it more or less completely. Where a mine has been opened by sinking down from the surface as is most usual, an adit is commonly begun from the bottom of some neighbouring valley, and is driven towards the vein with a slight inclination to allow the water to flow through it. Adits of enormous length have been formed in some mining districts so as to traverse a number of mines and carry off the water at the lowest practicable point. One of the most remarkable works of this kind is the great adit or principal level of Cornwall through which the waters of the numerous mines in Gwennap and Redruth are discharged. Its length, inclusive of its various branches, is nearly 40 miles, its depth varying from 60 to 180 yards. But the greatest length to which any branch appears to have been extended from the adit mouth is at Cardrew Mine, and measures about 5¼ miles in length. The highest ground which it has penetrated is at Wheal Hope, where the adit is 70 fathoms deep. This adit is 39 feet above the level of the sea at high water in Restronget Creek, into which the waters discharged from it flow. Another great adit known as the Ernst August Adit was finished a few years ago in Saxony, and drains a large series of mines in the Hartz Mountains, some of them to a deph of 444 yards. This adit with its branches is 14 miles in length, and has a gradient of 1 in 2,000. It occupied 13 years in construction, and cost £83,000.

W. T. GARTON,
Helen's Nook,
Golb[illegible]

7

Question 4. (E.)—Describe, with sketch, the methods of under and over hand stoping on a mineral lode.

Answer.—UNDERHAND STOPING—In underhand stoping a caunch is worked off beginning at the upper corner of a pillar and carried right across horizontally from winze to winze. When this caunch has gone a few yards a second one is set away immediately below the first one and so on, so that the unworked portion is like a staircase upon the steps of which the workmen stand. The useful mineral is separated from the deads and made to slide down boxes, or is passed down step by step until it reaches the level below. The deads are stowed away on timber supported by long baulks above the miners' heads,

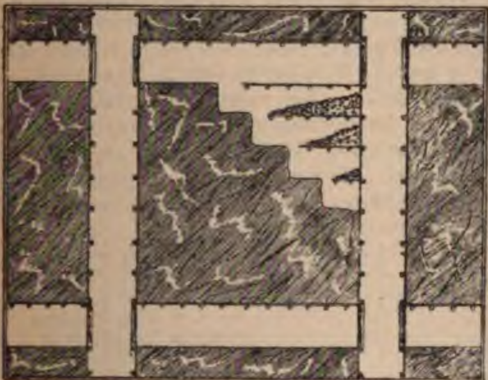


Fig. 1.—Underhand Stoping.

In this method a great number of men can be employed, two or more working in lifts above one another.

OVERHAND STOPING.—In this method a caunch is worked off the full width of the vein, and by 5 or 6 feet in height, starting from one of the lower corners of the pillar and working upwards to the level above. After one caunch has been driven a sufficient distance another one is commenced, and so on until the whole is removed.

Fig. 2.—Overhand Stoping.

The level below is well timbered, and the deads as they are separated from the ore are thrown on to it, and upon these the men stand while at work. The useful mineral is filled in boxes and lowered through passages left for it in the rubbish until it reaches the level below, when it is filled through sliding doors into the tubs as required.

THOMAS BEST,
Railway Street,
Tow Law,
Co. Durham.

Question 5. (A.)—What trouble arises from the presence of faults in the working of coal seams?

Answer.—Faults are of great difficulty in working coal seams, which may be proved as follows:—Faults are sometimes the cause of dangerous discharges of water. They injure the floor and roof and cause the coal to be of an inferior quality, and it assumes the appearance of a half-burnt cinder, or nearly so, for a distance of from 10 to 50 yards on each side. They are very injurious to ventilation, drainage, haulage, &c., and break up the inclination of the seam. They are very difficult to contend with when working calculations as to number and position of shafts, and the working plant most suitable for the royalty. Large quantities of gases are given off, as CH^4, CO, CO_2, H_2S. They are very difficult and expensive to pass through. The main roads and airways cannot be laid out with advantage, and calculating on the whole, the shaft is very difficult to sink (when they are very frequent), and the workings of the mine cannot be laid out in an economical manner.

ALBERT HART,
173, Kiveton Park,
near Sheffield.

Question 6. (A.)—State the advantages and disadvantages of the various forms of shafts used in mining.

Answer.—Forms of shafts may be classified under four heads—(1) circular, (2) rectangular, (3) elliptical, (4) polygonal. The circular resists pressure best, and for a given area offers the least rubbing surface to the air current; also gives greater ease in sinking; the cribs of one side of the shaft will fit any other part (which is not the case in rectangular and elliptical), but on the other hand it is a great waster of space. The rectangular form wastes less space than the circular, and is suitable for wooden lining,

and the cribs are easily made, but it does not resist pressure so well as the circular, and it resists the air current more. The elliptical form is a good resister of pressure, and does not waste so much space as the circular; it is a good form where pumps are required, but on the other hand, the cribs and bricks for lining are rather difficult to make. Polygonal form, not much used, suitable for wooden lining, but is of an impractible shape.

ALBERT HART,
173, Kiveton Park,
near Sheffield.

Question 7. (H.)—What size of hauling engine would be required to haul 100 tons per hour up an incline 2,000 yards long, rising one in five, steam pressure in boiler being 60 pounds per square inch? (Show each step of calculation.)

Answer.—The time allowed for haulage of the full tubs will not be more than 25 minutes per hour. The remainder being occupied in allowing the empty tubs to run back and be changed, &c.

100 tons hauled in 25 minutes = 4 tons per minute; assume half as much again for the weight of the tubs, friction, &c.:—Gross load = 6 tons or 13,340 lbs. per minute. 2·000 yards = 6,000 feet.

$$\text{H.P.} = \frac{13340 \times 6000}{5 \times 33000 \times \cdot 8} = 611 \text{ nearly}$$

Modulus is taken as ·8. The inclination is represented by the 5, and the 33,000 is the number of foot pounds per horse-power.

The diameter of cylinder =

$$205\sqrt{\frac{\text{Horse-power}}{\text{piston speed in feet} \times \text{pressure of steam in lbs.}}}$$

Take effective pressure of steam as $\frac{2}{3}$, boiler pressure = 40lbs.; and assume the piston speed to be 400 feet per minute.

$$\text{Diameter of cylinder} = 205\sqrt{\frac{611}{400 \times 40}} = 40 \text{ n'rly}$$

A cylinder 40 inches diameter = 1256·64 square inches piston surface, but it is usual to add half for general exigences.

Half of 1256·64 = 628·32 + 1256·64 = 1885 square inches.

This is the area necessary for one cylinder, but we will take double cylinder engine, so that the areas of the cylinders will be $\frac{1885}{2}$ = 924·5 square inches or 35 inches diameter.

Editor.

(The nearest solution to this was sent by SAMUEL THORPE, Chevet View, Ryhill, Wakefield, to whom the prize will be awarded.)

Question 8. (A)—What amount of fresh air should be provided per minute, for each man, horse, and light, in a colliery?

Answer.—We must comply with the C.M.R.A., 1887, general rule 1. An adequate amount of ventilation shall be constantly produced in every mine to dilute and render harmless noxious gases to such an extent that the working places of the shafts, levels, stables, and workings of the mine, shall be in a fit state for working and passing therein. An average man inhales one-third of a cubic foot of air per minute, and when working hard half of a cubic foot is required, and to supply sufficient oxygen for, say 200 men and boys each possessing lamps, and say 30 horses and ponies, I would endeavour to maintain a quantity of 70,000 cubic feet per minute, to allow each man 80 cubic feet per minute for every foot the seam is high, that is 4 feet. A little is left for leakages, old goafs, &c. The minimum quantity from various authorites are—100 cubic feet per man, 500 cubic feet per horse, 50 cubic feet per lamp. The air passing through a mine should always have the most attentive consideration of the manager.

JOHN N. WARDELL,
12, West Street,
Cross Lanes,
East Stanley, R.S.O.

Question 9. (M.)—When the roof in a goaf first begins to "weigh" in a fiery mine, what dangers would you apprehend, and what precautions would you take?

Answer.—When the roof in a fiery mine first begins to weigh, the dangers I should expect would be an extra discharge of fire-damp from the cracks and fissures of the newly exposed strata, and the breaking of the timber set to support the roof. I should put a competent person to watch for fire-damp, and competent persons to timber the roof where possible. by placing chocks, props, &c., and building pack walls where possible under the roof. I should stop all coal-getting until the roof settles, and only pay attention to the safety of the mine by putting as much air as possible through that part of the mine where the roof is on weight, examining all safety lamps minutely before allowing them to be taken into the workings for use, and if the air current is produced by furnace without a dumb drift, a close watch to be kept on the return air which should not be allowed to pass over the furnace in a dangerous state (General Rule 2), but I should prefer a fan to produce the air

current in a fiery mine, as there would then be no danger of an explosion by the air coming in contact with the furnace.

BENJAMIN NIGHTINGALE,
Ryhill, Wakefield.

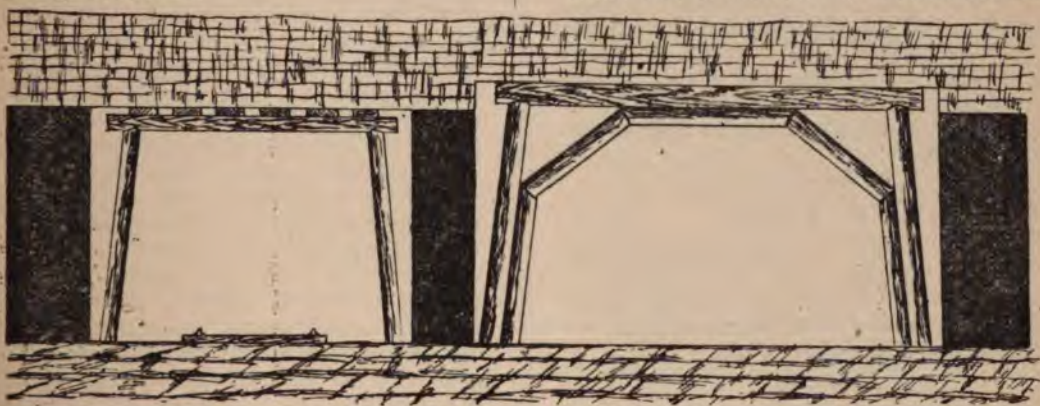
Question 10. (M.)—A district has been sealed off in consequence of a gob fire. How would you proceed to open it?

Answer.—In building up and sealing off stoppings I would insert a small perforated pipe, and if I found by the pressure gauge it was safe to reopen the district, I would see that I had a good and efficient ventilation up to the face of the stoppings. I should then commence by opening the stopping in the return, first carefully and gradually taking it down as I would naturally expect an outburst of deleterious gases, these would be immediately carried away into the main returns, and a means of escape should be provided for the workmen, as by merely stepping aside they would be out of reach of the danger as long as the stopping in the intake airway remained good. This being done and a hole of sufficient magnitude been made in the sealed-off stopping in the return, my attention would be directed to the stopping in the intake. I would, as before, commence by gradually taking it out, making a hole big enough so as to allow the current to pass through, I would then stop up the airway near the stoppings, which would force the air in and around the district affected. Before arriving at any definite conclusions, I would inspect the district with a locked safety lamp, and lay out my plans according to circumstances.

JOE GRAHAM.
Gt. Clifton,
Workington.

Question 11. (A.)—Explain, with sketch, the method of timbering a level, first, in moderately soft ground; second, in a comparatively wide road.

Answer.—The sketch shows the methods of timbering a moderately soft road and a wide road. Props of Norway wood are fixed on either side of the road at intervals of about



a yard, cross-bars are fixed on the top of these from one side to the other, and are held in position by the notches as shown, the loose material of the roof is prevented from falling by longtitudinal strips fixed on the cross-bars. The top of the props should lean towards the centre of the road at the top. This is sufficient providing the floor and sides will stand fairly. The method of timbering a wide road with stanchions, when it is inconvenient to place a prop in the centre of the road, will be easily understood from the sketch.

FRANK GRAY,
Keeper's Row,
Tow Law, Durham

Question 12. (M.)—If 30,000 cubic feet of air is being produced in an airway 1,200 feet long, 5 feet high, and 8 feet wide, how many feet would be produced if the air was split into three splits, the first being of the above dimensions, the second 1,500 feet long, 8 feet wide, and 7 feet high, and the third, 1,800 feet long, 6 feet high, and 9 feet wide, the power remaining the same?

All the competitors who sent in answers to this question misunderstood it. It not what quantity will pass in each split providing the total was 30,000 cubic feet, but what will be the number of feet produced under the new conditions if 30,000 cubic feet are produced in the first case. Competitors had better have another try at this question, and we shall hold the answe over until next issue.—EDITOR.

NOTICES.

One of our readers has informed us that "A Diploma of Merit" was offered in No. 11 of our journal for the best article on "How to prepare for the Managers' Examination," and the result has not been published. The explanation of this and perhaps other seemingly curious behaviour on our part, is in the fact that the paper is now under New Management as announced in last issue, and we are not in possession of any of the essays sent in, nor indeed did we know of the competition until referred to it by our correspondent. To remedy this defect, however, we will renew the prize, and competitors are requested to again send in their articles.

We have noticed that several readers who were formerly competitors in the answers to questions have ceased to send in their solutions. Now for what reasons we know not; but we can assure all competitors that their answers will receive a fair and impartial chance of the prize according to merit. Henceforth the questions will be divided into three stages, viz.. 1st, Elementary; 2nd, Advanced; and 3rd, Honours and Managers; and competitors will be confined to one, though they may choose any stage. This will enable the elementary students to have an equal chance of success with their more advanced readers.

PRIZE ESSAY.

We offer a prize of 2/6 for the best article on "How to prepare for the Managers' Examinations." Articles to be about 1,000 words in length, and must be received on or before the 2nd September, 1893.

CORRESPONDENCE.

To the Editor of "Mining."

12, West Street, Cross Lanes,
East Stanley, R.S.O.

Dear Sir,—Permit me to mingle my humble testimony along with those of my brethren who have received the same benefit as myself from the pages of your very valuable journal, "Mining;" it is worthy of all the praise that can be heaped upon it, for its quality and cheapness. I have read it since it first began, and I know its worth. I beg to ask the following questions:—(1) A horse-whim is placed so near to a wall that it will just turn, the length of the driving-bars is 15ft. How much of the wall must be removed to allow the whim to turn, if the driving-bars be increased to 20ft? (2) What part of America do you think best for a student to go to? And what passes should he have before he set off? I think favouritism predominates in the filling of good positions in this country.

J. N. WARDELL.

We will leave these questions to be answered by our readers, as in all probability someone amongst them will be in a better position to answer, at least the second question, than us.—Editor.

To the Editor of "Mining."

Dear Sir,—I read your letter on "The effect of Barometric Fluctuations on Gases," and as I am a general reader, and one very much interested in your valuable paper, "Mining," I venture to set before you my own observations of the above subject, which I have seen for the last eighteen months or so, at a large colliery in Northumberland. This colliery is one of the oldest in the north at present drawing coals, and the Low Main Seam, which is at a depth of 160 fathoms from the surface, is a 6-ft. seam of gas coal, but unfortunately it has almost all been worked out, thus there is a great amount of goaf, and consequently a large amount of fire-damp is given off; yet when the barometric pressure is high, scarcely any gas is produced, but should there be the slightest fall in the barometer, then and often before the fall takes place, gas is given off to a considerable extent; and although it is splendidly ventilated, with a good strong current of air, the gas cannot be carried off as quickly as it comes out of the goaf, and sometimes it backs out against the strong current for a good distance. Not long ago a headway going north, came across a small rise trouble where a tremendous quantity of gas came off although the barometer stood pretty high, and on boring, a holing was affected 3-ft. beyond the trouble, into some old workings, and the gas came out in such force and continued to do so for three or four days, that it could be heard at least 80 yards from the place. At the same colliery there is a 2½in. pipe carried down the downcast and connected to some old goaf, while at the back it is joined by another 2½in. pipe, and the gas comes out of the goaf and up the pipe to the pit heap, and is burned there, and when there is the least sign of a fall in the atmospheric pressure, it can soon be seen by the enlarged flame at the pipe ends.

I am, yours, &c.,

"TYNE-SIDER."

We are pleased to receive letters expounding the opinion and experience of our readers, and will endeavour to publish such letters according as space allows.—Editor.

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MINING

A Journal devoted to the interests of Mining.

). 21. Vol. I. SEPTEMBER 7, 1893. FORTNIGHTLY ONE PENNY.

ENERAL INFORMATION.

ELECTRICITY APPLIED TO MINING.

t a Meeting of the North of England ciation of Colliery Managers, the sident (Mr. T. O. Robson), in his address, the following particulars on the above ed subject:—

To Mr. Frank Brain, of the Trafalgar ieries, belongs the honour of having first duced successfully an electric pumping t for mining purposes, and this about teen years ago." Since then electrical ors have advanced by rapid strides as to mining.

In the County of Durham, Mr. W. man has utilised the power of one set of mos for a threefold purpose—hauling, ping and winding underground."

In Cleveland, Mr. A. T. Stevenson has ied an electrical motor to his drilling hine, and he is more than satisfied at results. I was present at the installation is plant, and the result was entirely factory. A hole four feet deep 1¼ inches eter was bored in one minute, or at the of 240 feet per hour. This result pares favourably with drilling machines en by compressed air and otherwise, but uld advise that a comparison of wear tear of cables and plant should be fully considered before final decision as ermanent efficiency is arrived at. In opinion however electrical motors will for many purposes, the test of time, if "sparking" can be avoided or safe-ded at in-bye stations where danger may nticipated from natural explosive agents rical motors will become in the future st a universal application for new mining lopment. Your attention has been tless drawn to a testing lamp of essor Cowes, of Nottingham, for the ction of gas in small quantities. In a er of great interest of this kind, I have no t that those of you who have to contend gas will give the lamp a fair trial; but uld be especially interesting to know how itrogen lamp compares with the Pieler , and other well-known detectors."

A NEW COLLIERY PICK.

At the Derby Industrial Exhibition was exhibited a patent pick, which has been brought out by The Union Pick and Tool Company. This pick consists of an ordinary shaft with a helve, into which small blades or points are placed and renewed as occasion requires, each renewal being equal to an entire new pick of the ordinary type. A miner need carry only one shaft or head into the mine, but can take any number of small points which may be carried about without inconvenience. It can be used as a single-headed pick in narrow workings, or on the other hand a hammer, adze, axe, chisel, or rammer, and may be inserted in either socket instead of the ordinary pick blade.

THE WORLD'S COAL PRODUCTION.

The following table gives the areas of the several mines in the different countries:—

	Sq. Miles.	Per Cent.
United States	250,000	58·7
English America	56,000	13·1
Great Britain	12,000	2·8
Spain	4,000	0·9
France	2,000	0·5
Germany	1,800	0·4
Belguim	518	0·1
Other Countties	100,000	23·5
Total	426,318	100·0

ALLEGED POISONING FROM CARBONITE FUMES.

A collier named John Fairhurst, died under peculiar circumstances on August 15th, consequent on an inhalation of carbonite fumes. The evidence given at the inquiry relative to his death, tended to show that the deceased ceased work six weeks previous to his death, and complained of being ill from the effects of an explosion of carbonite. Dr. Molyneux who attended the deceased during his illness, stated that in his opinion, death had resulted from abscess of the lungs, brought on by pleurisy. The jury after a lengthy deliberation, returned the following verdict:—That the deceased came by his death from pleurisy, accelerated by the inhaling of the fumes from a carbonite explosion.

HEAT.—By Calor.

Chapter IV.

Pyrometers.

THERE are various forms of this instrument, the object of which is to ascertain the temperature above the boiling point of mercury (about 350C) and they are principally used to find the temperature of fires, furnaces, etc. It has been discovered that clay contracts under high temperatures. Scientists have taken advantage of this property to construct an instrument known as the Wedgewood Pyrometer. The clay is moulded into a cylindrical form, and is then placed into a conical shaped metal groove. When the clay is red hot it exactly fits the end of this groove; on being placed in a greater temperature the clay contracts and slips down the groove. A scale of degrees is marked on the groove so that the temperature may be known; the contraction of the clay is not however proportioned to the increase of temperature, and therefore does not give accurate readings.

Daniel's Pyrometer consists of a rod of platinum fitted into a hole drilled out of a piece of black lead. The platinum is about an inch shorter than the hole and fits very loosely. Above the platinum is fixed a porcelain index; when subjected to intense heat the expansion of the platinum being greater than that of the black lead, the porcelain index is pushed up; this is prevented from falling back by a band of platinum; and by means of a suitable scale, the highest temperature to which the instrument was subjected is ascertained.

Wilson's Pyrometer is a water pyrometer and relies for its accuracy on the quantity of heat given to a known weight of water by a body (usually of copper or platinum) of known weight, which has been placed in the temperature required to be known and afterwards immersed in the water. The manner of determining the temperature will be explained in future articles on specific heat.

The Electrical Pyrometer is an ingenious method of ascertaining the temperatures of inaccessible places by means of electricity; this wonderful instrument was invented by Siemen, and is based on the principle that the electrical resistance of metals is in proportion to the temperature. An increase in the temperature causes a proportionate increase in the resistance, and *visa versa*. Two coils of wire of equal resistance are prepared, and the ends are connected by long thick copper wire, of an equal resistable power. One of the coils is placed in whatever position the temperature is to be tested, take for instance, at the bottom of the sea and the other coil in a vessel containing water. The temperature of the water in the vessel is then adjusted until the resistance in both coils are the same; the temperature of the water in the vessel is then taken by a thermometer, and the temperature of the position of the other coil can thus be deducted.

(To be continued).

BURNLEY COALFIELD.

THIS is a small Coalfield detached from the true Lancashire Coalfield, and situated a few miles north east of it. The two coalfields are separated by Millstone Grit, which is brought to the surface by an anticlinal arch, and Millstone Grit is the boundary of the whole of the Burnley Coalfield with the exception of a small portion on the south, and

ny places reaches to a great above the coal basin. That ı of the coalfield which under- e town of Burnley is the most ːtive, and it here forms a ., which is bounded on the ıd west by two faults, running parallel to each other. A erse section of the coalfield :he only unbroken succession ata, comprising a complete of beds from the Arley Mine the Carboniferous Limestone. ›tal thickness of the series is ːn 9,000 and 10,000 feet, and es about twelve workable seams total of 40 feet of coal. The ɔf succession of the coal seams ·nley are as follows:—

	FT.	IN.
ɜ Coal	6	0
w Coal...	3	0
óal	2	6
oal	5	0
Coal	3	0
‹ard or 5 feet Coal (with shales)	5	0
Bottom or 4-feet Coal ...	3	6
(impure)	2	3
ɔal and "Fish-bed"... ...	2	9
Coal 2-feet 4-inches Shale 1 „ 0 „ Coal 1 „ 8 „ } (Coal)	4	0
3ed	2	0
Bed	2	0
e Main Coal or Arley Mine	4	0
Coal Measures with Gannister and two or three other seams		
ıe Grit series with several Coals		

: area of the field is only 20 : miles, but it is very rich and ːtive. Mr. Hull's estimate of ːsources of the coalfield basin 7, was 189,000,000 tons.

XPLOSIVES.

Chapter V.

Flameless Explosives.

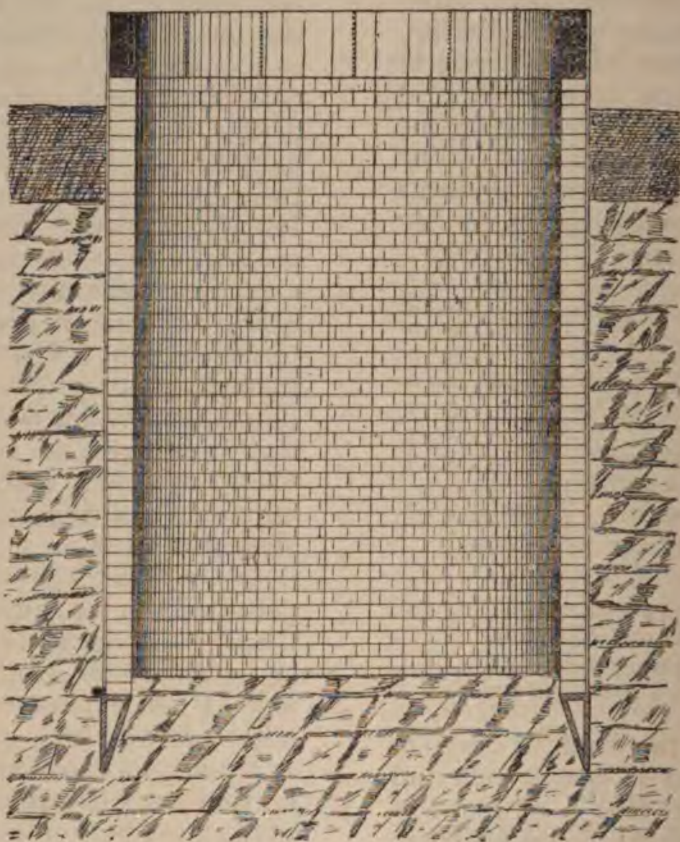
ımonite.—The advantages ːd for this explosive are as ɜ:—It is one of the most ful and safest of the High sives known to modern science; it consists of a mixture of two inexplosive substances, viz.:—Ammonium Nitrate, and Nitro-Naphthaline, contained in waterproof metallic cases. A grave defect in many modern High Explosives is a tendency during storage to lose strength by the absorption of moisture. With Ammonite this is entirely prevented by the use of damp proof cartridge cases, an advantage possessed by no other explosives of this class in the market. As it is also unaffected by the most intense cold the troublesome operations of drying in a steam bath to expel moisture, or thawing in a warming pan, have never to be employed. Its advantages for blasting purposes are as follows:—It is impossible to explode Ammonite by the direct action of flame, neither is it sensitive to concussion. The only method of exploding it is by means of a detonator, which is not contained in the cartridges as supplied by the Company, but is inserted at the moment of firing. It is equal in strength to No. 1 Dynamite and does not deteriorate by keeping, provided the cartridge cases are not damaged or broken; it has double the strength of Cotton Powder or any of the explosives having Gun-cotton as a base.

Numerous experiments have been carried out with Ammonite in some of the most fiery collieries in England and abroad, and in no instance has a mixture of coal gas and coal dust been exploded when proper tamping—*i.e.*, 3 inches of damp clay was employed; at the same time it possesses a freedom from any fumes, corrosive or otherwise, except the ordinary products of combustion, viz.:—carbonic acid, nitrogen and steam, little or no smoke being produced.

SINKING.

Chapter III.

ANOTHER method of sinking through loose strata or quicksand is by means of cylinders of iron bolted together. The following is the description of this method which was successfully employed to sink through fifty yards of sand:—The cutter or heading cylinder was strongly made of segments of iron bolted together. The top of the cutter cylinder was provided with a flange wide enough to allow of a walling of bricks and cement to be built upon it. The leader was first laid in position as soon as the surface soils were passed through, and plates of iron, similar to boiler plates, in segments about four feet high, and curved to suit the sweep of the shaft, were bolted or rivetted together so as to form a cylinder which was then bolted to the leader. On the flange of the leader was then built a wall with bricks and cement inside the iron cylinder. The weight of the construction thus formed was sufficient to force the leader a short distance in the sand. Another cylinder of iron was again bolted to the first cylinder, and the walling continued upwards. As the leader sank, the sand was excavated from inside the brickwork, but never to a depth less than six feet, from the bottom of the cutter. A cylinder of iron was again added, and the walling built up as before. This process was continued until the fifty yards of sand had been passed through, and the cutter was forced through several feet of the clayey strata which occured below the sand. Iron cribs were inserted at intervals in the walling to give it strength, and when the structure stuck or deviated from the perpendicular which occurred on several occasions, dry bricks were piled on scaffolds fixed in the sides of the shaft, boxes of iron having been previously built in the brickwork to receive the bearers, to avoid the necessity of breaking holes in the walling, which would weaken it materially. In cases where the walling toppled over slightly and got out of plumb, the dry bricks were piled upon that side of the shaft which was the highest, in order to right it again.



Cast-iron cylinders without any brickwork are sometimes used to pass through loose strata, but the cylinder must be much stronger, and made somewhat like water tubbing, the flanges however being inside. The necessary pressure to force these cylinders through the strata is obtained by employing hydraulic rams, or by using heavy weights. The method of sinking the cylinders is similar to the manner above described.

When such methods as these are employed, the utmost care and attention is necessary to keep the walling perpendicular, and the manager's time will be fully occupied in directing the work, and watching for the slightest deviation, in order that he may remedy it immediately. The spirit level and plumb-bob should be continually applied, and if one side is found to be higher than the other it must be righted at once.

(To be continued.)

PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by September 16th, 1893.

Question 1. (E.)—Describe the methods adapted for splitting, regulating, and crossing air currents in a mine.

Question 2. (E.)—What is a quarry, a mine, a vein, and a seam?

Question 3. (E.)—In what formations are coals found besides the coal measures? Do such coals differ from those of the Carboniferous period?

Question 4. (A.)—Describe, with sketch, the construction of an underground ventilating furnace, and its connection with the up-cast shaft of a fiery colliery.

Question 5. (A.)—State what gradients, with or against the load, you would prefer for endless rope and main-and-tail rope haulage, and give your reasons.

Question 6. (A.)—Describe, with sketch, the principle of the *Giffard* Injector.

Question 7. (A.)—How many cubic yards of material would be excavated from a pit 17 feet 6 inches in diameter, and 80 yards deep, and how much would this material weigh?

Question 8. (H.)—What peculiar kind of locomotives have been applied for traction underground?

Question 9. (H.)—How has electricity been applied to underground haulage?

Question 10. (M.)—In enlarging the sectional area of a shaft, which was about 540 feet deep, and in which considerable water flowed from the sides in addition to the water which lodged in the old shaft, it was found that the water in the sump would be lost occasionally for eight or ten hours, and then return. Considerable gas was given off by the strata, and the volume of the gas given off was increased when the water was absent. What was the reason of this?

Question 11. (M.)—How would you prepare to keep a large colliery open, in case of a pending strike?

Question 12. (M.)—What distance from the top will the cages pass each other in a shaft of 200 yards deep, the winding being done with a drum of twelve feet diameter at the lift, and a flat rope three-quarter inch thickness?

The letters E. A. H. and M. in front of the questions are to denote to which class the question belongs, whether Elementary, Advanced, Honours, or Managers.

Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

Cheques and P.O.O. to be made payable to STROWGER AND SON, Wigan.

ANSWERS TO QUESTIONS

In No. 19.

Question 1. (E.)—How is coal found, and what are the terms used to describe—(*a*) The character of the deposit. (*b*) The interruptions and disturbances to which they may have been subjected?

Answer.—Coal is found in beds or seams separated from each other by more or less thick strata or beds of shale, sandstone, or grit, and indurated clay, the whole being termed, collectively, the coal measures, and belonging to a still larger formation of stratified rocks called the Carboniferous formation. These measures with their accompanying beds of coal are generally more or less inclined, the dip varying from a few inches in a fathom to angles which occasionally approach the vertical. Sometimes the seams are found in a zig-zag form, as in the Mons district of the Belgian Coalfield. The term used to describe the nature of the deposit is stratified, meaning that the particles of which they are composed are arranged in beds, layers, or strata. The terms used to describe the interruptions are slips, dykes, throws, troubles, baulks, and swellies, but more generally as faults.

SAMUEL THORPE,
Church View,
Ryhill,
Wakefield.

Question 2. (E.)—How would you sharpen and temper the bit of a borer for boring by hand in rock? What shape and dimensions would you prefer?

Answer.—The temperature should not be raised more than to show a blood-red heat; it should then be hammered to its proper shape and thickness. During the process of tempering steel, if the skin of the tool be clean, certain colours are seen which denote the molecular changes going on at different temperatures, To understand this clearly take a bar of steel with a clean skin, which has previously been made very hard by plunging it into water while very hot, slowly heat this bar and you will notice a wave of straw colour pass over its surface; on a further increase of temperature the straw will change into purple, and by still further heating the purple will change to a blue colour. Now each of these colours are indices of different degress of hardness, the straw being hard, the purple being less so, and the blue moderate hardness, that is supposing the bar to be cooled immediately the particular colour is seen. The cooling is done by plunging it into water several times, but not to keep it still, for by doing so a line of fracture is produced coinciding with the surface of the water. The chisel will break at this line when put to use. Mining tools should all be tempered in coal tar and not in water, for tar being a bad conductor of heat is less apt to produce a line of fracture; besides, the chemical action is such as to restore the carbon lost by heating in the fire. For boring by hand three drills are used:—1ft., 2ft., and 3ft. long, respectively. The cutting edge of No. 1 being 2ins., No. 2 1¾ins., and No. 3 1½ins. on the curve, and shaped liked a V in section. They are made from ⅞in. iron, tapered towards the point, and tipped or pointed with steel.

JOHN N. WARDELL,
12, West Street, Cross Lanes,
East Stanley, R.S.O.

Question 3. (E.)—What is a coal seam?

Answer.—A coal seam is a layer or bed of the black brittle substance known as coal. It is generally found inter-stratified with sandstones and shales in the Coal Measures along with the underlying beds of Millstone Grit and Mountain Limestone of the Carboniferous formation. Coal seams sometimes extend over several miles in area, and vary from one inch to several feet in thickness. It is composed of mineralised vegetable matter formed by peat bogs and forests which grew ages ago. By pressure and heat it has lost its gaseous constituents, the carbon remaining, with the gases oxygen, hydrogen, nitrogen. Beneath the coal seam a layer of

upward, and the ventilation increased. 3rd.—By waterfall. Water is allowed to fall through a perforated funnel placed in the downcast shaft, and in falling the water is broken into small drops which creates a partial vacuum, the water drawing the air down with it. Neither the steam jet nor the waterfall give good results, and are seldom used except as temporary expedients in case of explosion. Both systems have serious drawbacks. 4th.—By furnace. The general principle of furnace ventilation depends on the fact that by heating the air in the upcast shaft it expands and becomes lighter, bulk for bulk, than the air in the downcast, and by this means a current of air is produced, the heavier cold air in the downcast displacing the lighter warm air in the upcast. The furnace gives good results in deep dry shafts. 5th.—By fan. I prefer fan ventilation. A fan causes a current of air to circulate through a mine by reducing the pressure of the atmosphere at the top of the upcast shaft, and the pressure of the atmosphere at the top of the downcast forces the air through the mine. The fan will put in circulation a greater quantity of air in proportion to the quantity of fuel consumed than the furnace for a shallow pit. In cases of emergency the ventilation may be increased by simply increasing the speed of the engine. Fiery mines should always be ventilated by fans, as no dumb drift will be required, as is enforced in furnace ventilation by general rule 2, C.M.R.A. Should an explosion occur in a mine where a furnace is used the ventilation would be stopped, but if a fan was used it would be kept in motion, as general rule 3, C.M.R.A., requires that it shall be in such position and placed under such conditions as will tend to ensure its being uninjured by an explosion. A fan is also to be preferred in a wet shaft.

THOMAS BEST,
Railway Street,
Tow Law, Co. Durham.

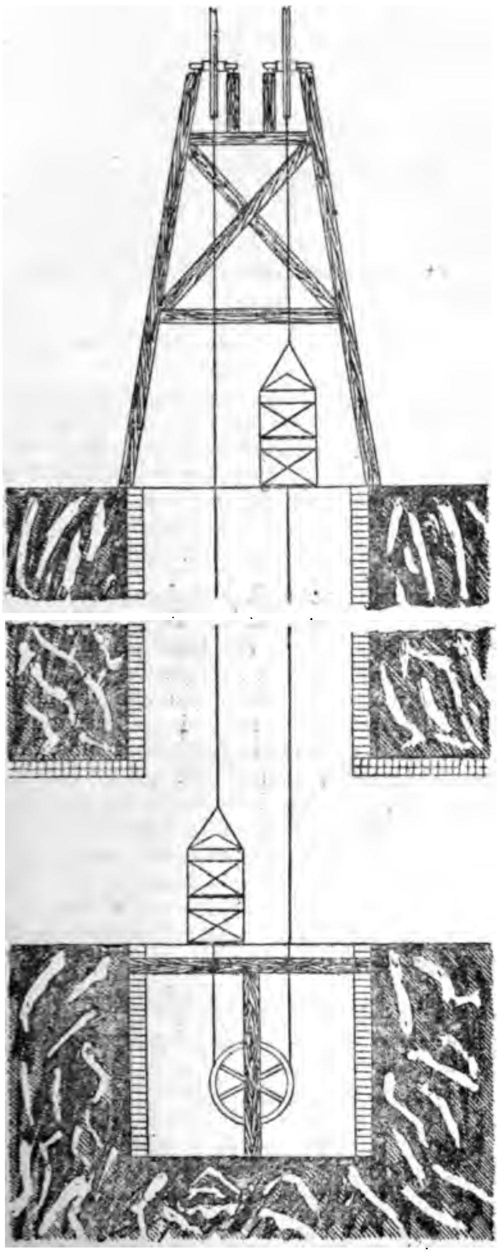
Question 6. (H.)—How is coal handled between its arrival at bank, and its discharge into the railway wagons?

Answer.—During the last eight or ten years great advancement and special improvements have been made in the way and mode of handling, or in other words, in dressing and screening coal after its arrival at the pit top, and these improvements have been sensibly felt on a large scale, in the financial advantages resulting from them, by colliery owners wherever they are fitted up. The common method of handling coal which was, and is still, in use at many collieries is as follows:—The tubs are pulled out of the cage, taken on to the weighing machine, then to the screen-head, and toppled over without any decanter or kick-up, and the coals are emptied or deposited with force on to the screen bars. This way of handling does considerable damage, and breaks the coal up, and greatly reduces its value. In other collieries the tubs are emptied by the kick-up, tippler, or, as it is properly called, the decanter, which turns in a vertical plane on a horizontal axis, and is so constructed that the centre of gravity of the tub and decanter is above the axis of rotation when the tub is full, and is also above the centre of rotation when the tub is emptied and is upside down. The coals fall on to the bars as in the first case, and the screens form a plane, having an inclination of about thirty degrees. The bars are placed three-quarters of an inch or one inch apart, and in passing over them the coals are screened or sized. The large round coal goes over these bars on to a tray or table at the bottom of a screen, where men and boys pick and clean out the shale, dirt, and basses, and then rake or shovel the coals into the wagons. The small coal that has fallen between the bars either falls into a hopper, or on to another screen which only passes the duff or slack, the "peas" or seconds being conveyed into another wagon. At many collieries belt screens or jolting screens are employed. When belts are in use the coals are sized as described, and then delivered on to travelling tables which are constructed of jointed plates, and form an endless band or belt turning on octagon rollers. The plates are made of iron, ten inches broad, and four-and-a-half feet wide. The belt moves at an elevation of two-and-a-half feet from the floor, and men and boys are stationed along its side to clean out the dirt, shale, and pyrites, the speed of the belt being about sixty feet per minute. In all cases, these tables have given great satisfaction. But the best class of screen and tippler or decanter for preventing the breakage of coal is the jolting or jigger screen. The tub is run on the kick-up, which consists of a cylindrical cage which turns on friction rollers, the tub turns right round in depositing or emptying, and the coal goes direct against the slope of the screen, thus causing less damage to be done to the coal. There is a friction pinion pressed on by a lever, and this fits into a groove in the circular belt at the end of the decanter, and this pinion is worked by a belt actuated by the jigger screen engine. The screen is made of strong wire meshes, and a double eccentric causes a backward and

forward motion to the screens. The forward motion of the upper screen coincides with the backward motion of the lower screen, thus causing the coals not to have so much of a throw. The coals from the upper jig pass on to the under one, so that three wagons can be filled at once on parallel lines of railway: No. 1 with round coals, No. 2 with seconds or cobbles, and No. 3 with slack or duff, and as before men and boys pick out the refuse. Inclination of the screens is about ten degrees with the plane of the horizon.

SAMUEL DAVIES,
New Co-op. Houses,
Mapplewell, near Barnsley.

Question 7. (H.)—What methods of drawing minerals have been proposed, other than winding drums? Give any sketch you may consider necessary to illustrate your answer.



Answer.—The Koepe system of colliery winding dispenses altogether with winding drums and substitutes a V pulley. One winding rope answers for the purpose of winding and is attached to both cages, instead of having a separate rope for each. This rope having a cage at each end simply passes round an ordinary constructed V pulley on the crank shaft. A balance rope passes from the bottom of one cage round a pulley fixed in the sump at the bottom of the shaft, and then up again to the bottom of the other cage. This is the special feature of the Koepe system. The advantages claimed for this system are: 1st.—Massive winding drums are dispensed with, thus avoiding the enormous weight to start and stop each winding. 2nd.—A smaller engine house is required. 3rd.—The pair of engines can be brought closer together thus making the crank shaft shorter. 4th.—The rope always curls round the same diameter. 5th.—Only one rope is actually used for winding. Disadvantages: 1st.—The rope is liable to slip upon the drum pulley. 2nd.—If the rope breaks the two cages fall to the bottom of the pit. 3rd.—The difficulty of re-capping because there is no spare rope to fall to.

JOHN H. RONTREE,
Mapplewell,
Barnsley,
Yorkshire.

Question 8. (H.)—Give an account of the mines on the great flat lode south of Redruth and Cambourne.

The answers to this question were merely copy, and therefore not suitable for insertion.

Question 9. (M.)—What are the conditions to be observed as prescribed by the Coal Mines Regulation Act of 1887, for shot-firing in "fiery" and "non-fiery" mines? (The exact words of the Act are not required).

Answer.—Safety lamps not to be unlocked except at the lamp station, or for firing shots. In conformity with the provisions contained, a person appointed either for examining safety lamps or for firing shots shall not have on him anything to open the lock or loose the same, and must not have any lucifer match, or

anything that will strike a light except within a completely closed chamber which is attached to the fuse of a shot. In "fiery" mines no description of fuse is safe in itself. It is liable, when burning, to allow fire to escape into the atmosphere of the mine. No shot should be ignited in any "fiery" seam by means of a lamp flame or by a wire which has been made red hot by inserting through the gauzes of a safety lamp, or any other source of fire which, when applied to the lighting of the fuse, must come in contact with the atmosphere of the mine. That all work involving blasting in mines should be only entrusted to experienced workmen. Examine all places within twenty yards radius. Have all places where dust is lodged thoroughly watered for a radius of twenty yards, unless the explosive is used with water so as to prevent inflaming the dust. But if the same be a part of a main haulage road, showing dust on roof and side, then the same conditions must be observed and all workmen removed from the seam in which the shot has to be fired, and from all seams communicating with the shaft on the same level, except the men engaged in firing the shots, and such others—not over ten—attending to furnaces, engines, boilers, signalls, horses, or inspecting the mine.

JOSEPH WALLWORK,
44, Johnson Street,
Tyldesley.

Question 10. (M.)—Give size of an engine you would use to bank 600 tons of coal in 10 hours, up a drift 430 yards long, rising 1 in 2, the engine drawing 4 trams each journey. Each tram holds $34\frac{1}{2}$ cwt., and the weight of a tram is $15\frac{1}{2}$ cwt., pressure of steam on engine 55lbs. Men are raised and lowered down the above drift. Give size and quality of rope you should use, what sort of attainment you would have between the trams, and how you would attach the rope to the trams.

Answer.—600 tons in 10 hours = 60 tons per hour. A gang of four tubs would carry $4 \times 34\frac{1}{2}$ cwt. = 6 tons 18 cwt. ∴ 60 tons would require $\frac{60}{6\cdot9} = 8\cdot55$ gangs. 8·55 gangs per hour = 6·9 minutes per gang. Out of this time say two minutes is occupied in hauling the full tubs. The load to be raised =

Coal in 4 tubs	6 tons 18 cwt.
Tubs, 4 at $15\frac{1}{2}$ cwt. each	3 „ 2 „
Gross load...	10 tons 0 cwt.

Inclination = 1 in 2, ∴ nett load $\frac{10}{2}$ = 5 tons. A steel rope six pounds per yard has a safe working load of six tons. 430 yards at 6 lbs per yard = 2580 = gross weight. $\frac{2580}{2} = 1290$.

	lbs.
Nett load of coal and tubs = 5 tons or	11200
„ „ rope	1290
Nett load...	12490

To this add $\frac{1}{28}$ of gross load for friction = $\frac{1}{14}$ of nett load. $\frac{12490}{14} = 892 + 12490$ = 13382 lbs. total nett load.

Take modulus of engine as ·8

$$\frac{13382 \times 430 \times 3}{33000 \times 2 \times \cdot8} = 327 \text{ H.P.} \quad \text{H.P.} = \frac{\text{area of cyl.} \times \text{st. pressure} \times \text{piston ft. p. min.}}{33000}$$

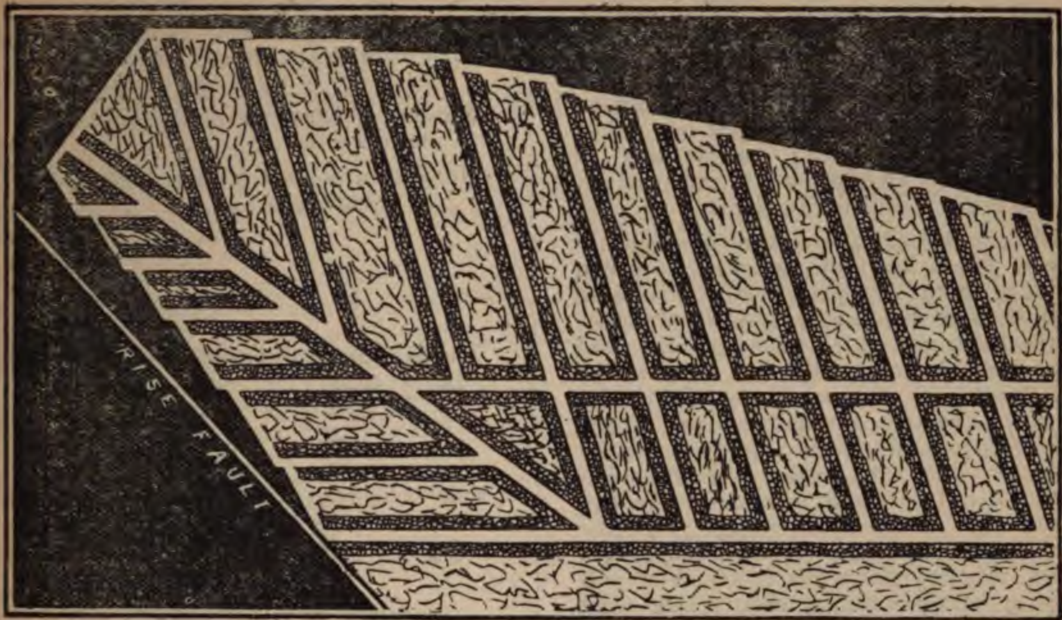
$$327 = \frac{A \times 55 \times 400}{33000} = 490$$

Area of cylinder = 490 sq. inches. Diameter of cylinder = $\sqrt{490 \div 7\cdot854}$ = 25 inches nearly. One cylinder 25 inches diameter, and with a stroke twice this size would do the work, but as this engine has to perform services similar to a winding engine, I would employ two cylinders of that size.

For a mine so highly inclined the front wheels of the trams should be considerably less in diameter than the back wheels, or, if the main drift was the only part approaching this inclination, I would use two carriages with the wheels arranged as previously stated, each carriage to hold two trams, and coupled together with D-link and pin, and a short chain to each draw-bar. In case the carriages were not suitable I would use the spring safety link between the trams and attach the rope to the first tram by a D-link and pin. I would also connect the first and last trams together, as an extra safeguard, by means of a chain passing under the boxes.

JOSEPH WALLWORK,
44, John Street,
Tyldesley.

Question 11. (M.)—Give a brief description of the colliery at which you are now engaged, and state the mode of working, and distance between stalls, etc.



Answer.—The colliery where I am at present engaged is situated out of Barnsley, about one-and-a-quarter miles in the direction of Wakefield. There are four shafts: two winding pits, one pumping, and the up-cast or fan pit. Depth of the shafts about 150 yards, having two cages in each shaft, holding two tubs in each cage. There are about 800 hands employed, nine deputies, and two under-managers. We are working the Barnsley seam, which varies in thickness, and dips nearly in all directions from the pit bottom. Both pits are subject to large feeders of water, and also carbonic acid gas, and fire-damp. The royalty is interrupted very much with a large number of faults which makes it expensive to work. The system of hauling is the main-and-tail rope, and ponies drawing tubs from the working face to the the pass-byes or landings as they are called; these are coupled into sets from 34 to 50, according to the gradient, and then they are ready to be drawn to the pit bottom with engine power. This engine is situate at the surface. The seam is inter-stratified with clay or alum shale, and inferior dirt-parting. The coal is of excellent quality for domestic, steam, and coke-making purposes. The clay is filled up, and the dirt parting is very strong and useful for building the packs. Since the present manager has been here a great many difficulties have had to be surmounted so as to win the coal by the cheapest, best, most economical, and the safest way because of the number of faults to contend with, a very large area of goaf, in the neighbourhood of the pit eye, a post or pillar of coal left here and there, and the far end of the royalty not reached. But great credit is due to the manager for his skill, integrity, and perseverance in the execution of his duty. The general mode of working is the longwall, on the short lift system. Gates are opened out every 20 yards apart, width of gates being from 9 feet to 10 feet wide. The gate packs are 3 yards wide, and the gob packs two yards wide. These are built about every 5 yards apart. The packs are built with the middle dirt out of the seam. Sometimes a few chocks are used where there is a scarcity of stones for packers. The coal is worked off in lifts, about 4 yards of buttocks or slices, up to the gate above. The softs and some of the day-bed or top coal is got from between the packs in the goaf. The mode of lighting is by the use of the Mueseler type of safety lamp.

SAMUEL DAVIES,
New Co-Op. Houses,
Mapplewell,
near Barnsley.

Question 12. (M.)—State the advantages and disadvantages of electric lighting and signalling underground.

Answer.—The advantages of electric lighting for mines are:—Superior light, economy, cleanliness, and the air not vitiated. The disadvantages are:—Fear of sparks from wires if not fitted up properly.

or from a broken lamp, and thereby igniting fire-damp; fear of personal injury from contact with the wires, if high tension current is used; if the engine or dynamo breaks down all lights are put out unless accumulators are used; an accident to one lamp puts all others out in same circuit. It also needs a skilled attendant.

Electric Signalling.—Advantages: Quickness of action, less first cost and repairs, can be rung from any point with same ease regardless of distance or number of angles of the road, and it is much quicker and more reliable, especially for long roads. Disadvantages: Sometimes out of order by the current leaking, especially in damp mines, and delay in finding point of leakage; easily tampered with. At a colliery in the Rhondda Valley a fall occurred, something like two months ago, upon a main haulage road (the signalling being done by electricity), the debris bringing the wires to the floor and keeping them in contact, when sparks were produced strong enough to ignite the dust, but by the timely arrival of the under-manager all danger was averted.

JOHN DIXON,
18, River Row,
Treorkey,
Glamorganshire,
S. Wales.

QUESTION 12, No. 18.

Question 12. (M.)—If 30,000 cubic feet of air is being produced in an airway 1,200 feet long, 5 feet high, and 8 feet wide, how many feet would be produced if the air was split into three splits, the first being of the above dimensions, the second 1,500 feet long, 8 feet wide, and 7 feet high, and the third, 1,800 feet long, 6 feet high, and 9 feet wide, the power remaining the same?

Answer.—The quantity of air would be increased directly as the sum of the areas and inversly as the cube root of the rubbing surfaces.

Original Airway.
- 5 × 8 = 40 sq. feet area
- 5 + 5 + 8 + 8 = 26 ft. perimeter
- 26 × 1200 = 31200 sq. feet of rubbing surface.

Second Split.
- 8 × 7 = 56 sq. feet area
- 8 + 8 + 7 + 7 = 30 ft. perimeter
- 30 × 1500 = 45000 sq. feet of rubbing surface.

Third Split.
- 6 × 9 = 54 sq. feet area
- 6 + 6 + 9 + 9 = 30 ft. perimeter
- 30 × 1000 = 54000 sq. feet of rubbing surface.

Area of airway in first case = 40 sq. feet.
Area of airways in second case = 40 + 56 + 54 = 150 sq. feet.

Number of sq. feet rubbing surface in first case	31200
Number of sq. feet rubbing surface in second case	31200
	45000
	54000
	130200

The quantity of air produced in second case =

$$\frac{150 \times 30000}{40 \times 3\sqrt{\dfrac{130200}{31200}}} = 70{,}000 \text{ cubic feet nearly.}$$

EDITOR.

(Up to the time of going to press we had not received any *correct* anwer to the above question.—Ed.)

CORRESPONDENCE.

Glebe Row, Bedlington,
Northumberland,
August 26th, 1893.

Dear Sir,

When we compare "Mining" now with what it was at the commencement, we see a wonderful improvement, so marked is the improvement that every reader will acknowledge that it has got into better hands of management. It contains more matter, and of a higher quality, and the order in which everything is arranged cannot be but noticed; but with all this improvement, there is one thing that still remains the same—and that is the price of it. This demonstrates the generosity of the Editor and Proprietors of "Mining." I have been a successful competitor ever since the commencement, and I have always found everything on the square. I have done what I could to make the paper a success, by giving about fifty copies away amongst my friends, which induced some of them to become readers; and if every subscriber could induce one more to become a reader this next four months, it would double the circulation, and increase its value to the Editor and Proprietors. Wishing the paper every success.

Yours faithfully,
JOHN GRAY.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

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B.—Previous to this issue the "Geology" ·les have only dealt with special parts of subject picked indiscriminately; we ·ose, however, giving successive illus- ·d articles henceforth, the first of which ·ars below.—Editor.

GEOLOGY.

CHAPTER I.

EOLOGY literally means "The History of the Earth," being ved from two Greek words, *Ge*— earth, and *Logos*—a word or y. It treats of the various ıations of rocks which go to ·e up what we call the earth, and e especially the Crust of the th, for this is all that we have ·tically any knowledge of; also animal and vegetable organisms ·h flourished or decayed during building up of the various strata included under the one title of ·logy. One of the most important ıges which rocks undergo after ·g deposited is known as *weathering*. s means, as its name denotes, action of the various natural ıts which exist; it is well known soon, for instance, a stone at bottom of a swift running brook, ever sharp-edged it may have ı at first, loses its angularity, becomes in a very short time ·mooth and round as though it been cast from a mould; in the e way for example, on the sea ·t, all the irregularities and pro- ·ons on the bordering rocks, being constantly battered by the sea and the wind and rain, are ceaselessly being torn away from the solid, and often fragments are left as angular as before.

Glacial action is a great agent in the weathering of rocks. Under this heading may be included the action of *Frost*. The water that falls from above in the form of rain and dew sinks into the soil and fills up the pores in rocks. Suppose then the temperature at that time is only a few degrees above freezing, and suppose afterwards that it sinks down to freezing point, the water in being converted into ice, expands considerably, and as a consequence, will push aside the particles of rock or soil between which it may be held. When this takes place in soil, all the particles are bound fast together by the ice which acts as a cement. When a thaw eventually sets in the ice turns into water, and the particles which were so solid when held by ice are now loose fragments, with no influence to bind them together; in fact, the very water which bound them together at first, may be the chief means of disin- tegrating them entirely by washing them away. Rain has a peculiarly powerful action considering the slight force with which it appears to strike objects in its fall, but as it passes through the atmosphere it absorbs many of the gases from it, some of which give it a distinctly

acid nature. With the oxygen it absorbs out of the air it oxidises many substances which have an affinity for the gas, and causes them to rust; when this has taken place, the disintegration of the whole affected by the rust is only a matter of time. The carbonic acid gas derived from the atmosphere by the rain dissolves some of the soluble portion of the rust and carries it away. As a rule, it may be said that the action of rain is to cause the outer portions of rocks to rot from the surface inwards.

(*To be continued.*)

HEAT.—By Calor.

Chapter V.

Expansion of Solids.

As was previously stated, solids expand with an increase in temperature. The expansion which a body undergoes in length is spoken of as its *linear* expansion, and the increase in volume as its *cubical* expansion. A simple method of illustrating the linear expansion of a metallic bar is shown in Fig. 6. It is supported at one end by a fixed bar which prevents it from moving in that direction. At the other end it is supported by a projection of metal which is fixed to the end of a lever which acts upon an index passing over a graduated arc. A spirit lamp is placed under the metal bar and the expansion causes the index to move over the graduated arc, and the smallest elongation is manifest from its multiplying effect. To show the cubical expansion of a solid, take a brass or copper ball which is of a size that will just pass through the ring of a retort stand (Fig. 5). Heat the ball over the flame of a lamp, and you will find that it will not pass through the rin until it has cooled down and con tracted to its former dimensions.

Fig. 5.

Fig. 6.
Illustrating the Cubical and Linear Expansion of Solids.

That fraction of a body, which expands on being heated one degre is known as its *co-efficient of expansio* For example, a body a yard long o being heated one degree C. expand one-quarter of an inch. Therefor its co-efficient of expansion = [illegible] The following table gives the co efficient of expansion of variou metals as determined from numerou experiments :—

Co-efficients of Linear Expansion, fo One Degree C.

Lead	·000028	= [illegible]
Brass	·000018	= [illegible]
Copper	·000017	= [illegible]
Steel	·000012	= [illegible]
Cast Iron	·00001	= [illegible]
Platinum	·000008	= [illegible]
Glass	·000008	= [illegible]

The co-efficient of cubical expansion is taken at three times the linear expansion. This is not quite accurate, the correct number being a very little over three, but this is the number usually adopted, and the proof is unnecessary in these articles, it being my intention to deal only with those details of heat relating to mining. To illustrate more clearly the co-efficient of expansion of metals I will give an example.

A range of cast-iron steam pipes are fixed in a shaft 600 yards deep, when at a temperature of ten degrees C. What will be the increase in the length of the pipes when they are raised to a temperature of one hundred degrees C., by the passage of the steam?

According to the above table one yard is increased ·00001 yard for one degree C. Therefore when six hundred yards are heated ninety degrees the increase will equal ·00001 × 90 × 600 = ·54 yards = 19·44 inches.—Answer.

(The student will perceive from this example the necessity of fixing expansion joints to steam pipes, especially when in an up-cast shaft.)

(*To be continued.*)

EXPLOSIVES.

CHAPTER VI.

FLAMELESS EXPLOSIVES.

Bellite.—This explosive is the invention of Mr. CARL LAM, and consists of nitrate of ammonia and di-or tri-nitro benzol. It is claimed to possess all the advantages possessed by roburite, such as insensibility to blows, friction, and vibration, and is unaffected by long storage. From recent disinterested experiments at a local colliery it is stated that this explosive is a little more powerful than roburite, and blows the coal better, giving more round coal. At very high temperatures it burns away like fat.

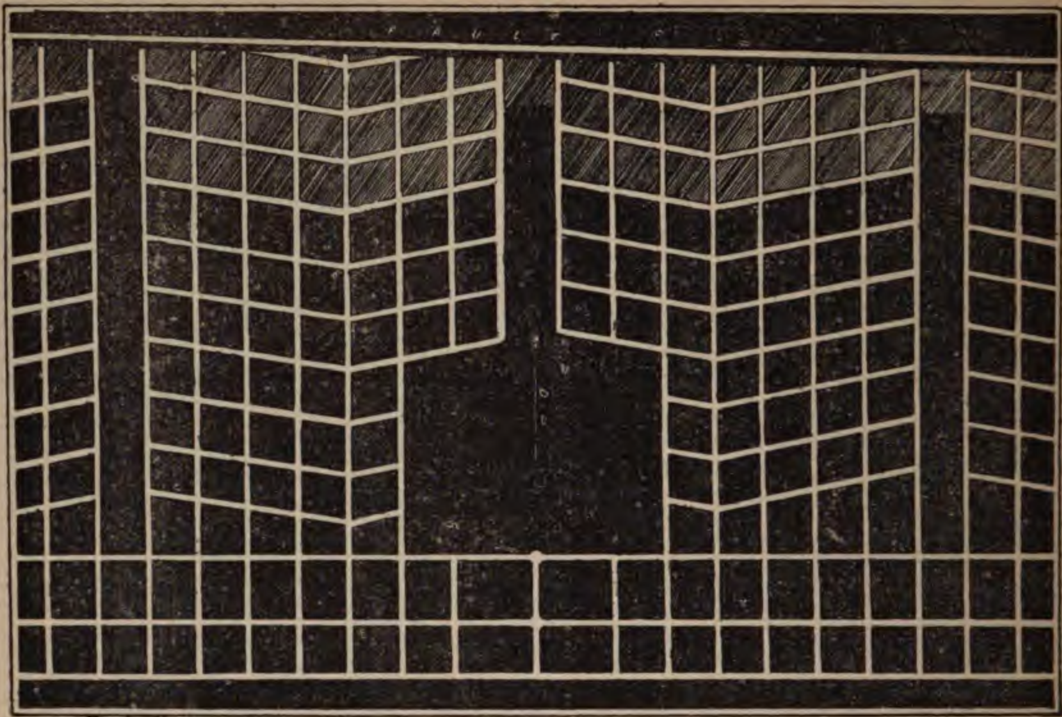
Securite consists of nitro-dinitro benzol and nitrate of ammonium or potash. The advantages claimed for it are similar to the other flameless explosives.

For fiery mines none other than flameless explosives should be used. As to the particular one to be used is a very different question; but that roburite has given excellent results is certain, and the more recent bellite has proved itself good, but its reputation is not yet assured, although it gives great promise of being second to none. Very great objections have been raised to the deleterious gases given off from the explosion of some of these explosives, and although the makers contend that the gases produced are less in quantity than those produced from ordinary blasting powder (the nature of the gases being the same), yet there is undoubted proof of the injurious effects received from working with them.

(*To be continued.*)

METHODS OF WORKING COAL.

THE illustration shows a modification of the bord and pillar method of working and is now extensively employed. It consists of dividing the area of coal to be worked into "districts" or "panels" separated from each other by long barriers of coal ranging from 30 to 50 yards in width. Three levels are driven on each side of the pit, and places are started up-brow, the first to be driven being the brows which are intended to be the centre of that district. At intervals up the centre brow, roadways are driven, rising slightly towards the dip on either side; this enables the tubs to be drawn with greater facility, it being usual to fix a self-acting jig in the



Plan shewing Pillar and Stall Barrier Method of Working Coal.

centre brow. The workings are carried up to the fault shown, which is supposed to be the boundary of the coal to be worked by that mine, and the pillars are brought back in the ordinary manner, the barrier pillars being, however, taken out after the side pillars. The advantages of this system of working are :—(1.) Less risk of explosion, as each district has a separate air current, and should an explosion occur in one district the others would not in all probability be affected. (2.) The danger of creep occurring is minimised by reason of the barrier pillars, and again, should creep occur in one district there is less chance of it spreading to the other districts. (3.) Each district can be treated as a separate mine, and advantage taken of the powers granted to such.

Instructions to Competitors.

In answer to numerous competitors as to the manner in which contributions should be written for our Journal, we would advise that they be written on foolscap paper and a margin be left on one side. The use of foolscap paper is not essential, and if the competitor has other suitable writing paper by him we would not press this matter. The Examination Questions for Competition need not be written, but the number of the question must be put in the margin. Not more than one answer must be written on one paper, and this on one side only; in case the answer extends over two sheets of paper, it is sufficient to pin them together. The name and address of the competitor must be written below each solution. Sketches must be drawn on a separate piece of plain unruled paper, and must be fastened to the answer to which it belongs. If competitors will only leave the ends of the package open when posting, or place them in an envelope and leave the flap ungummed, they can be sent at book rate, and competitors will save themselves a considerable amount in the course of a year.

ARTICLE COMPETITION.

e Prize of 2s. 6d. has been awarded to Smith, 13, Hardwick Place, Hunslet Leeds.

' TO PREPARE FOR THE CÖLLIERY MANAGERS' EXAMINATION.

ƆAL-MINING is one of the greatest industries extant, and examinations are, I believe, ng more severe year after year. ; fitting that they should be, use the men who anticipate aging our mines should be men have proved their ability to :t, control, and protect life and erty. I shall assume that the :ing candidate for a manager's ficate is well grounded in elemen- mathematics. This is most ntial. Without a good know- e of arithmetic to work out the ılems, and a knowledge of algebra ınderstand algebraical formulæ ›nnection with mining problems, hort, without a good knowledge ıathematics it is impossible to eed at a colliery managers' ıination. Mathematics is the en key which unlocks almost y other science. The candidate t learn to work out his problems rly and neatly, in fact he must ı to do all his work in a neat, ness-like way. After the student ımes moderately versed in mathe- .cs he is in a position to push ıd, and his studies will not only ·apid but pleasant. The can- te must be *thorough.* He must ;ider nothing beyond his notice. must ask the why and wherefore :verything. To the attentive, evering mining student nothing :ivial. He must endeavour to ɜrstand the natural laws abont ɜin phenomena. If the aspiring lidate is a practical working miner, or a pupil in an engineer's office, he must make the colliery with which he is connected his school, and must master every detail both above and below ground. Nothing must escape his notice. He must accustom himself, from the data he is able to collect, to find the horse-power of the engines in or about the mine. He must learn how the mine is set out and worked; how the difficulties in connection with faults, &c., are over- come. A good deal of the practical and theoretical work in connection with pit sinking (and this section plays an important part in an exam.) can only be learned by working in, or very often visiting, a sinking pit. I cannot impress too much the necessity of thoroughly mastering the practical part of the candidate's department, and this can only be done by studying the pit with which he is connected, and visiting other collieries. The candidate must learn to draw and sketch fairly well. He should be able to plot a survey well and correctly, or give a plan of the surface arrangements, and should be able to sketch quickly and well, pieces of machinery in or about the mine. This will greatly assist him at his exam., because a sketch will convey a better idea to an examiner's mind than what a written description possibly could. All the subjects necessary can be learned at the evening schools connected with the Science and Art department—not that the student should depend on verbal teaching; he should read all the books he can on mining. He should also study, not merely read, such publications as "Mining," and work and re-work all the problems in each issue, until each problem becomes his own. He should also keep by him a large-sized note book into which he must enter all rules,

formulæ, definitions, etc., which he comes across while reading or listening to lectures, and he should begin a year or two before the exam. The writer adopted the above course and found it to materially assist him, in fact two hours before the examination takes place the candidate can revise the most important part of his two years' study. The C.M.R.A. is a bug-bear to many. The examiners may recite a rule and then ask the candidate the number of it, or *vice versa* he may state the number and ask the candidate to recite it. The following is the plan I adopted:—I carefully read the rules and then I wrote and re-wrote every rule, until I could almost recite every one *verbatim*. In conclusion, the following is a summary of the principal subjects to be learned:—

MINING PROPER.

Boring, sinking, pumping, systems of working, various plant arrangements, ventilation, gases, timbering, tunnelling, haulage, how to deal with accidents, &c.

EXTRA SUBJECTS.

MATHEMATICS, a good knowledge of
GEOLOGY, a fair knowledge of
MECHANICS, cover the syllabus of the elementary grade, S.K. Science and Art Examination
STEAM AND STEAM ENGINE, cover syllabus of advanced grade, S.K. Science and Art Examination. This includes elementary knowledge of Heat
ATMOSPHERE, miscellaneous questions on
CHEMISTRY, elementary knowledge of, with special study of mine gases, explosives, etc.
DRAWING, freehand sketches, quickly, of machinery and other mining appliances and constructions
ELECTRICITY, elementary knowledge of such parts as relate to mining
SURVEYING, a knowledge of how to make loose and fast needle surveys, and be capable of plotting same. It is not necessary to be a good surveyor
C.M.R.A., to be known thoroughly

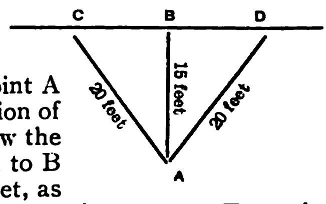
CORRESPONDENCE.

To the Editor of "Mining."

Dear Sir,

I offer the following solution to the question given by J. N. Wardell, in No. 20 of your valuable Journal. A horse whim is placed so near a wall that it will just turn, the length of the driving bars being fifteen feet. How much of the wall must be removed to allow the whim to turn if the driving bar be increased to twenty feet?

Let the line C B D in the accompanying figure represent the position and direction of the wall, and the point A the centre position of the whim. Now the distance from A to B will be fifteen feet, as



the original bar would just turn. From the centre to each end of the gap which requires to be made will be twenty feet, and is represented in the figure by A C and A D. Therefore the length of wall to be pulled down C D. Now the angle A B D is a right angle $\therefore AD^2 = AB^2 + BD^2$ *i.e.*, $20^2 = 15^2 + BD_2$. $\therefore BD2 = 175 \therefore BD = \sqrt{175} = 13{\cdot}22$. B D is one-half of C D $\therefore$ the length of wall to be pulled down $= 13{\cdot}22 \times 2 = 26{\cdot}44$ feet.—Answer.

Yours etc., T.D.

WANTED

All well-wishers to send us the names and addresses of any schools with which they are acquainted where mining is taught. Also, if possible, the probable number of students and the names of the lecturers. Our intention is to forward specimen copies to the schools throughout the kingdom, in order that this Journal may be more extensively circulated, as we feel certain that if it is once read its own merits are capable of paving the way to success. If our readers will comply with the above request they will materially help us to accomplish this end, and will be adopting the best means of showing their appreciation of our past efforts.—EDITOR.

EXAMINATION QUESTIONS,

With Answers, by

THOS. FLETCHER, First-Class Certificated Manager

The following questions for the examination of Candidates for Certificates of Competency were set in the Lancashire and North Wales District, June, 1892.

FIRST-CLASS CERTIFICATES OF COMPETENCY.

Elementary Education & Ventilation.

QUESTION 1.—You have 120,000 feet of air per minute passing into a mine at a temperature of 45° F., the temperature of the return at the bottom of the up-cast shaft being 82° F: What is the volume of air circulating in the up-cast per minute? Show calculation.

ANSWER.—The volume of air is increased $\frac{1}{459}$th of its volume for every increase of 1° F., measuring from freezing point, *i.e.*, 459 cubic feet of air at freezing point will be 459 + 45 = 504 cubic feet at a temperature of 46° F., and will be 459 + 82 = 541 cubic feet, at a temperature of 82° F. Therefore for every 504 cubic feet of air passing into the mine there will be 541 cubic feet circulating in the upcast. $\frac{541 \times 120000}{504} = \frac{2,705,000}{21} =$ 128,809·5 cubic feet.—Answer.

QUESTION 2.—With furnace and fan ventilation state where, in each case, you will find the highest and lowest water gauges in the whole course of the ventilating current.

ANSWER.—With furnace ventilation the water gauge is greatest at the bottom of the shaft, and the lowest water guage will be found furthest away from this point, whether in mouthings up the shaft or in the mine itself, being nil at the far end and at the surface. With fan ventilation the water gauge is the highest at the fan drift, and diminishes towards the shaft bottom, and is nil at the far end.

QUESTION 3.—What shape of airways give the best results—(*a*) as to economy in construction; (*b*) as to friction?

ANSWER.—The square or oblong shaped airway is the most economical, but the circular shape offers less rubbing surface for a definite area.

QUESTION 4.—What are the principal points to be observed in the management of a fiery mine to comply with the Coal Mines Regulation Act?

ANSWER.—The principal points to be observed are:—1st, an adequate amount of ventilation in every part of the mine; 2nd, all lamp stations must be above ground, and the lamps examined and locked by competent men, and tested in an explosive mixture before being taken into the mine; 3rd, if practicable avoid the use of explosives, or use none but the flameless explosives as roburite, bellite, &c.; 4th, if a furnace is used for ventilation a dumb drift must be provided.

QUESTION 5.—Mark the ventilation on the annexed plan of a fiery mine.

(We are unable to re-produce plan.—Ed.)

Principles of Mechanics & Machinery.

QUESTION 6.—What is the normal strain on a hauling rope on both sides of the main driving pulley under the following conditions:—Endless rope, engine on surface, shaft 130 yards deep, one down brow 1,350 yards long, average dip 1 in 12, from which 50 tons of coal per hour is hauled in tubs weighing 3 cwt. each, and hold 6 cwt. of coal, the diameter of the rope being 1 inch?

ANSWER.—The normal strain on both sides of the main driving pulley will be found as follows:—Circumference of rope squared × ·45 = weight in lbs. per yard. $1 + 3·146^2 \times 150 \times ·45 = 675$ strain on each rope. Say it travels twice round per hour. Then we have 25 tons of coal on the rope at one time, and 15·5 tons of tubs on each side. 12·5 + 25 = 37·5 tons on the full road. The inclination is 1 in 12, therefore the force due to gravity $= \frac{37·5}{12} = 3·125$ tons = 7000 lbs. $\frac{1}{56} \times \frac{37·5}{1} = 1,000$ lbs. allowed for friction of full tubs. The weight of rope on the full side $= 3·1416^2 \times 1,350 \times 45 = 6,075$ lbs. The gross weight of rope on full side $= \frac{6075}{12} = 506$ pounds force due to gravity. $\frac{1}{28} \times \frac{6075}{1} = 217$ pounds allowed for friction.

Therefore strain on full rope = 675
7000
1500
506
217

9898 pounds.

On empty side friction acts against the strain ∴ strain = (675 lbs. + $\frac{1}{12}$ × 12·5 tons + 506) — ($\frac{1}{56}$ × 12·5 tons + 217 lbs.) =

2797 pounds.—Answer.

QUESTION 7.—What type of pump would you adopt to raise 300 gallons per minute up a shaft 180 yards deep? Give dimensions and sketch of main parts of engine and pump.

ANSWER.—I would adopt a double-acting Cameron pump, 3-feet stroke, and twenty revolutions per minute. The square of the diameter in inches × the length of the stroke in feet × the number of strokes per minute × ·034 = theoretical number of gallons raised per minute. Ten per cent. is the usual amount allowed for leakage of pump. Therefore we will calculate on raising 330 gallons per minute. $330 = D^2 \times 3 \times 20 \times 2 \times \cdot 034$. $D^2 = 81$ $D = 9$ inches. The modulus of pumping engines is ·5. A gallon of water weighs 10 lbs. Take pressure of steam as 60lbs., ∴ $\text{H.P.} = \dfrac{300 \times 10 \times 180 \times 3}{33000 \times \cdot 5} = 98.$

$$\text{H.P.} = \frac{\text{Area of cyl.} \times \text{l. of stroke in ft.} \times \text{No. of strokes} \times \text{st. pres.}}{33000}$$

$98 = \dfrac{\text{Area of cyl.} \times 3 \times 40 \times 60}{33000}$ area of both cylinders = 450 sq. inches. Diameter of one cylinder $= \sqrt{\dfrac{225}{\cdot 7854}} = 17$ inches.

Double-acting pump, three-feet stroke, twenty revolutions per minute, nine-inch diameter pump, seventeen-inch diameter cylinder, steam pressure sixty pounds.

QUESTION 8.—Given a lever seven feet long, weighted with 45 lbs. at one end and 35 lbs. at the other, where would the fulcrum have to be placed so that the lever would be balanced?

ANSWER.—Call the end of the bar at which the 45 lbs. is A, and the other end B.
The distance from A to the fulcrum × 45 =
" " B " " × 35.
$35 + 45 = 80$. The fulcrum will be $\frac{35}{80} \times$ 7 feet = 36¾ inches from A.

QUESTION 9.—What sort and weight of tram rails do you consider best for underground use, when the loaded tubs weigh 10 cwt.?

ANSWER.—I consider bridge rails of 10 lbs. per yard most suitable for ordinary purposes, and for main road steel rails of 12 lbs. per yard.

QUESTION 10.—In putting a range of six-inch steam pipes in a shaft 300 yards deep, what would you guard against, and how would you do it?

ANSWER.—I would guard against the expansion of the pipes, due to an increase of temperature, by fixing stuffing boxes and glands at intervals of about 100 yards.

QUESTION 11.—Describe the relative advantages of round and flat ropes.

ANSWER.—The advantages of flat ropes over round ropes are greater flexibility, require less pulleys, smaller engine-houses, and keep the cage steadier. The advantages of the round rope over the flat rope are greater strength for the same weight, less cost, and last longer.

QUESTION 12.—What does the C.M.R.A. require as to (*a*) Winding drums; (*b*) Fittings of a steam boiler?

ANSWER.—The requirements are that drums shall have sufficient flanges or horns to prevent the rope from slipping; and steam boilers must be fitted with proper safety valves, steam gauges, and water gauge.

(*To be continued.*)

PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by September 30th, 1893.

Question 1. (E.)—How do you account for the cleavage of shale and slate?

Question 2. (E.)—Explain the term vacuum.

Question 3. (E.)—What is the object of mine ventilation?

Question 4. (A.)—What is meant by the negative load of a winding engine, and how is it counteracted?

Question 5. (A.)—How would you ventilate a tunnel which is being driven singly several hundred yards.

Question 6. (A.)—Describe, with sketch, the the action of a syphon.

Question 7. (H.)—Describe the endless rope method of haulage.

Question 8. (H.)—Having a pit 300 yards deep, state size of pillars you would leave to protect it. State also the chief considerations that would guide you to determine this.

Question 9. (M.)—How would you keep a tunnel straight in a given direction, and how would you keep it at a given inclination?

Question 10. (M.)—What do you consider to be the reason of more falls of roof occurring during the night than in the day.

(The Answers to Questions are of late increasing in length, and cover a considerable part of our available space. We would be pleased if Competitors condensed their solutions a little, though we wish it to be distinctly understood that this does not necessarily mean leaving out any part of the answer.—Editor.)

The letters E. A. H. and M. in front of the questions are to denote to which class the question belongs, whether Elementary, Advanced, Honours, or Managers.

ANSWERS TO QUESTIONS
In No. 20.

Question 1. (E.)—How do you account for the fact of coal seams being at present below the sea?

Answer.—It is evident from what we can learn of the strata which contain the coal seams that they all have, more or less, been deposited by the action of water. This theory almost invariably holds true of the very recent deposits, since there is scarcely a foot of our earth which has not at one time been under the sea. This can easily be understood by us being able to find sea shells at the top of mountains. Now if it is true that these mountains have been on the floor of the deep sea, they must have been lifted or forced up by volcanic action. Most probably then, as we know that the shores of many continents are sinking at the present time, while those near at hand are steadily rising. Then so we must account for our British coal seams being at present under the sea by the rising and sinking of the earth's crust caused by volcanic action.

JOHN COOK,
28, Smithey Green,
Smithies, near Barnsley.

Question 2. (E.)—How have the fossils of animals and plant remains, footprints, etc., been preserved through the long ages which have passed since their occurrence?

Answer.—When animals and plants cease to live chemical action sets in, and their soft parts are soon obliterated; even their bones or other hard parts, if sufficiently long exposed, fall to dust. The operation of nature however led to the preservation of organic remains in the first place by covering them up, and afterwards converting them into stone, where they are preserved from further decomposition, and often become as permanent as the rock in which they are embedded. Marine animals, as they die, fall to the bottom of the sea and soon become covered over by sedimentary matter. The remains of animals living on the face of the earth may be covered up by sand blown over them, or they may in time be buried by the growth of peat mosses—rivers overflowing their banks are often very destructive to animal life—and may become buried by the silt left by the rivers, or they may be carried by the flood to the mouth of the river and become buried in the deposits there accumulated. Footprints, etc., have been made and preserved in the following manner. Animals, in walking over the wet sand, mud, or clay upon the sea beach, or upon the side of a lake or river, leave impressions of their feet, and if these impressions are soon covered up with sand or mud gently strewn over them as by the rising tide, they may be permanently preserved, especially if the soft surface of the ground has been well baked by the sun before another layer has been placed upon it. In a similar manner are preserved worm tracks, ripple marks, and even the impressions made by raindrops.

BENJAMIN NIGHTINGALE,
Ryhill, near Wakefield.

Question 3. (E.)—How is water raised from a deep mine without pumps?

Answer.—Water may be raised from deep mines by winding, by means of a cistern of considerable size attached to the bottom deck of the cage. When lowered into the sump it is filled by means of a self-acting clack in the bottom of the cistern, and when raised to the surface the water is discharged by means of an automatic arrangement which opens a valve at the side of the cistern, thus emptying the water while the tubs are being changed. A great quantity of water may be raised by this method, and it is very economical. In many cases, at night the ordinary cages are taken out and water cages inserted in their places, the filling and discharging of the tank or water cage taking place by a suitable arrangement of self-acting valves.

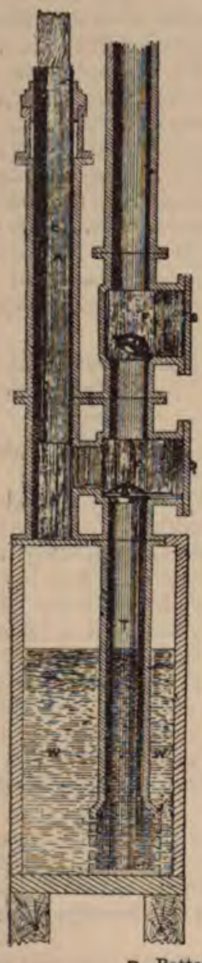
ROBERT DAVIDSON,
12, Grange Villas,
near Chester-le-Street,
Durham.

Question 4. (A.) — What changes are observed in coal seams near faults or troubles, and how are workings laid out in faulty ground?

Answer.—The changes found near a fault or trouble are:—If the coal seam throughout is of a very hard nature, when it is nearing a fault it is observed that the coal is of a softer nature, and when within a few yards of the fault the coal is of an inferior quality, and is of a calcined or blackened and cindery nature, having been burnt by the fiery mass which has been filled into the fissures and cracks in the earth's crust. This points out that there has been a convulsive movement of the earth's crust. These faults sometimes discharge a great quantity of water and dangerous gases. The most economical method of working a seam of a faulty nature is by the bord and pillar. By this method it will be seen that when a fault is found there are only two of the main headings to be cut through the fault, and the seam on the other side can be opened out again, whereas it would be a great expense if all the facing of the longwall system hadto be cut through the fault.

GEORGE DAYKIN,
24, High Gurney Villa,
Bishop Auckland.

Question 5. (A).—Describe with sketches the principle of construction of the plunger pump?



REFERENCES:—

A	Plunger.	B	Bottom Clack.
C	Top Clack.	D D	Doors.
E	H-piece.	F	Valve Chamber.
W W	Water	T	Tail Piece.

Answer.—The manner in which the plunger pump works is as follows:—The plunger, which works in a cylinder through a stuffing box and gland, on ascending produces a partial vacuum in the H-piece. This causes the clack or valve B to open, by reason of the pressure on the water in the cistern connected with the tail piece, and the water rushes upward above the clack. The weight of the water closes the clack B, and on the plunger descending the water is forced through the valve C into the chamber F, and up the column of pipes connected to the chamber. This process is continually repeated and the water is forced up the shaft. The cistern is usually kept filled by means of an ordinary lift pump which lifts the water from the sump. The same power is applied to work both pumps, and this is accomplished by attaching set-off pieces of timber to the main pump rod, and then connecting these to the bucket lift. The chambers E and F are provided with doors to allow free access to the valves.

SAMUEL THORPE,
Chevet View,
Ryhill, Wakefield.

Question 6. (A.)—What are the special advantages and disadvantages of fixing steam engines underground?

Answer.—The special advantages of fixing engines underground are: 1st.—There is no more economical method than having engines near their work and the boilers near the engines, as there will be less loss from condensation than when the steam has a long length of pipes to pass through. 2nd.—The heat from the engines can be made to assist the ventilation. 3rd.—The engineman can see the landing and starting off of the runs, less length of rope is required, and there is

less friction with rope and pulleys when haulage engines are fixed underground. 4th.—There is more room in the shaft, and pumps work better near the water, and the pumps and engines can be fixed away out in the workings, and force the water to the surface.

The disadvantages are: 1st.—Steam is very inconvenient underground, doing harm to the strata and causing the roof and sides to fall in. 2nd.—Danger from underground fires as the timber in the immediate neighbourhood of the enginehouse is very easily ignited, and steam boilers accentuate the evil and danger if placed underground. 3rd.—If the engines are placed to the dip there is danger of having them buried with water in case of breakdown of the pumps or extra in-flow of water into the mine.

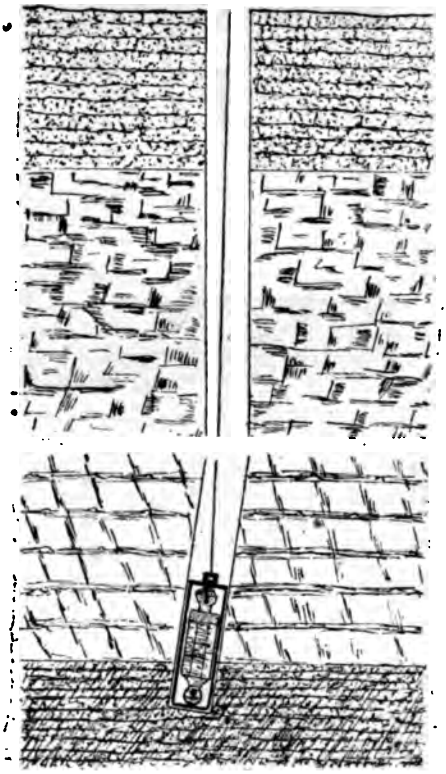
SAMUEL THORPE,
Chevet View,
Ryhill, Wakefield.

Question 7. (H.)— What are the most approved methods of washing coal slack?

Answer.—There are numerous machines in the market for this class of work each claiming their respective merits, although the principle in each is nearly the same—separating the refuse from the coal by taking advantage of buoyancy, coal having a less specific gravity than shale or pyrites, and is easily buoyed up in agitated water while the heavier particles sink. In *Robinson's* Coal Washer the coals are placed in a conical pan and the water descending from an elevated cistern enters the bottom of the pan by a perforated pipe and buoys up the coal, the shale and pyrites falling to the bottom are deposited in a wagon by means of a trap consisting of two slides and a box. In *Ramsey's* Washer the coals and water are run along a slightly inclined spout in which dams are placed at intervals. The coals are washed over the dams and flow into settling ponds, but the refuse falls into pockets behind the dams. In the common jigging machine the water has a wave motion due to the action of pistons and the coal is buoyed up, the heavier debris falling as before.

JOS. GRAHAM,
Great Clifton,
Workington.

Question 8. (H.)—What methods have been employed to determine the deviation of boreholes from the vertical?

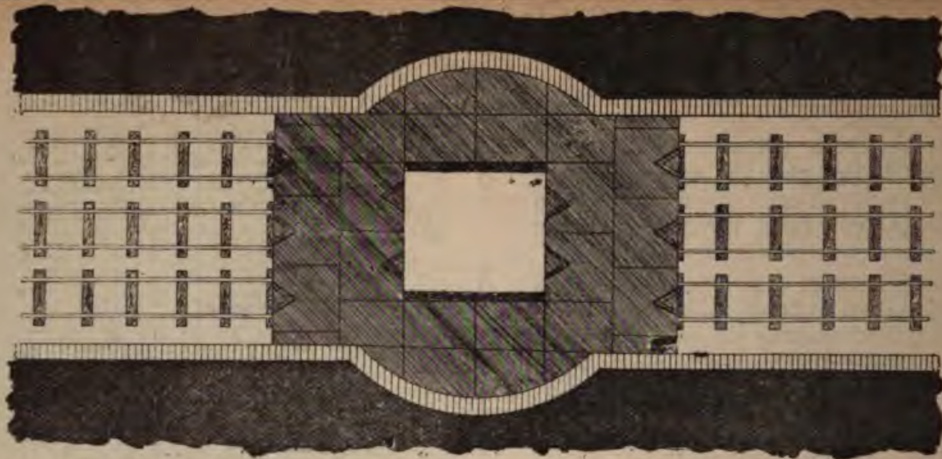


Answer.—The deviation from the vertical may be determined by an instrument called the "clinostat." It consists of a glass tube six inches long, containing a solution of gelatine liquid, into which is placed a magnetic needle. The glass tube is inserted into a brass tube (guiding tube), and lowered down into the hole by means of a cord every 100 feet. As the gelatine cools it becomes solid, and the angle at the surface of it will represent the deviation from the vertical, while the magnetic needle will point the direction. The needle is supported in the liquid by means of a float, and a fine cord attached to it. The top bulb contains a plumb-bob of glass. The sketch shows the arrangement.

ALBERT HART,
173, Kiveton Park, near Sheffield.

Question 9. (M.)—Describe and illustrate by sketches and dimensions, the way you would lay out the roads at the bottom of the drawing shaft of a colliery when the quantity required to be drawn is 600 tons of ten hours?

Answer.—I would have the bottom of the shaft bell-mouthed to a sufficient diameter to allow room for the passage of tubs on each side of the cages, as shown in sketch. I



would place iron plates for several yards on each side of the shaft, and have three or four sets of rails extending from these plates. There should be a slight incline towards the shaft on each side to facilitate the moving of the full tubs. This arrangement would enable tubs to be sent from one side of the cage to the other in case the quantity of minerals obtained on each side of the pit were unequal.

ALBERT HART,
173, Kiveton Park, near Sheffield.

Question 10. (M.)—Describe fully what arrangement of signals you would adopt for winding from two different levels or stages in a shaft, as occasion may require throughout the shift?

Answer.—I should have direct communication between each level and the engine-house by means of electric signals. By this arrangement wires are conducted from the engine-house to each stage or level, being each insulated from one another, and all enclosed in wood cases held fast to the sides of the shaft by means of iron holdfasts. At the extremity of the wires, viz.:—at the engine-house and each level, they are connected to the batteries (generally *LeClanche's*), which supply and maintain an electric current in the wires, and from these batteries off-shoots are carried on to bells to receive the alarm made at any of the other terminals. The bell to adopt is also a consideration, and I should prefer a single stroke bell to a trembler, as the latter is more liable to go wrong if an accumulation of dust gets inside, and again, the former gives more distinct and clear signals. A proper code of signals should be arranged so that the engineman may know from what seam he receives the alarm, or this is preferably done by means of distinct wires to each seam from the engine-house. The table of raps ought to be strictly adhered to, and when the signals are first put in, an additional wire might be carried down in case of accident to any wire constantly in use.

JOHN LAVERICK,
Eppleton Colliery,
Hetton-le-Hole, R.S.O.

Question 11. (M.)—Many colliers are injured or killed by falls. State what you have noticed to be the principal causes of such accidents, and how they may be prevented?

Answer.—The principal cause is probably due to the ignorance of those entrusted with the work of setting the timber, care not being taken to examine the sides and roof sufficiently before inserting the support. Another source arises from the frequent occurrence of caldron bottoms, which leave the surrounding strata without any warning whatever, very frequently resulting in accidents to the workmen. Then again, slips or faults are met with as the workings advance, which sometimes give off much water or gas, and these are a source of great danger to the men. Where the seams are thicker, and especially when worked by longwall, the strata are very liable to settle down from the surface into the space formerly occupied by the coal, and crush all the timber in that particular district or face, thus endangering the lives of the workmen.

As a means (partial) of prevention of these serious mishaps very great care should be taken in setting the timber. The work should be done by men thoroughly experienced, and men with a thorough knowledge of the nature of the coal, and the mine generally. The hewers should not be allowed to do it, as they grudge the time thus spent, but men should be allotted to this work, or rather the whole of the timber should be set by the deputy or fireman, whose knowledge of the nature of the strata should be, and is very often unquestionable.

JOHN LAVERICK,
Eppleton Colliery, Hetton-le-Hole.

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MINING

A Journal devoted to the interests of Mining.

No. 23. Vol. I. OCTOBER 5, 1893. FORTNIGHTLY ONE PENNY.

HEAT.—By Calor.

Chapter VI.

Expansion of Liquids.

THAT liquids expand on being heated is well known to my readers, a common illustration being found in the expansion of mercury in the ordinary thermometer. Of course it is only possible to find the *cubical* expansion of liquids, and the *co-efficient* of expansion is that fraction of its volume which expands on being heated 1°C. The following are the co-efficients of a few liquids:—

Co-efficient of Expansion at 1°C.

Alcohol	·00116
Sulphuric Acid	·0006
Water	·000466
Mercury	·0001

Expansion of Gases.

Gases expand much more than either solids or liquids, but it is altogether different in its action. For example—A tightly corked flask may be full of air, and be subjected to heat and not appear to be affected by it. Although the air does not expand in this instance, yet its elasticity is increased, *i.e.*, the air on the inside of the flask presses on the sides of the flask with a greater force than the air outside, the tendency being to burst the flask; and it would most probably burst the flask or blow off the cork if heated to a sufficiently high temperature.

A better illustration of the expansion of gas will be to partly fill a bladder with air, and then hold it before the fire; it will be seen to become gradually inflated, and on its removal from the fire shrink to its former dimensions.

From these examples it will be evident that to arrive at the proper expansion of gas, the pressure must be maintained at a constant temperature.

Advantage is taken of the expansion of gases by heat to produce the ventilation in furnace shafts. The principal is as follows:—The air in the upcast shaft, when heated, expands and rushes up the shaft, consequent on its lightness, and the colder air from the downcast shaft flows in to take its place. This air in turn likewise becomes heated, rises, and another quantity of fresh air takes its place, and so in this manner a regular current is produced. All dry gases have the same co-efficient of expansion, and this is ·00366, or $\frac{1}{273}$ of its volume for every increase of 1°C. in temperature, *always measuring from freezing point.*

(Example)—You have 100,000 cubic feet of air per minute passing into a mine, at a temperature of 12°C., and the temperature of the upcast is 32°C. What is the volume of air circulating in the upcast per minute? 273 cubic feet of air at 0°C. becomes — 273 + 12 = 285 at 12°C., and will be 273 + 32 = 305 at 32°C. Therefore, for every 285 cubic feet that passes into the mine, 305 will circulate in the upcast.

$$\frac{100{,}000 + 305}{285} = 107{,}018 \text{ cu. ft.—Ans.}$$

EXPLOSIVES:—The following is a summary of the explosives treated in previous articles together with their composition, and any remarks which they occasion.

Name of Explosive.	Composition.	Remarks.	
Gunpowder ...	Salt Petre, 75 %; Sulphur, 10 %; Charcoal, 15 %	In use in this country 2½ centuries	
Nitro-Glycerine ...	Nitric Acid and Glycerine...	Very powerful but dangerous to use	
Nitro-Gelatine ...	Nitro-Glycerine, Guncotton, Collodion and Camphor	Safer than Nitro-Glycerine and quite as powerful	Nitro-Glycerine Compounds.
Dynamite (Kieselguhr) ...	Kieselguhr, 25 %; Nitro-Glycerine, 75 % ...	Freezes at ordinary low temperatures and great care must be taken to thaw it	
Vulcanite ...	Nitro-Glycerine 43 % and Mealed Gunpowder ...		
Litho-Fracteur ...	Nitro-Glycerine, 55 %; Kieselguhr, 21 %; Charcoal, 6 %; Bi-Carbonate of Soda, 15 %; Manganese Oxide, 3 %		
Horsley Powder ...	Nitro-Glycerine and Chlorate of Potash ...		
Forcite ...	Nitro-Glycerine and Cellulose	Not affected by water, burns freely in open air and is stronger than dynamite	
Brains Powder ...	Nitro-Glycerine, Chlorate of Potash & Coal Dust		
Atlas Powder ...	Nitro-Glycerine, Nitrate of Soda, Carbonate of Manganese and Wood Fibre		
Carbonite ...	Nitro-Glycerine, 90 %; Carbon, 10 %	Flameless	
Gelatine Dynamite	Blasting Gelatine 80 %, with nitrate of potash and wood pulp in proportion	Used principally for blasting rock	
Guncotton ...	Cotton Waste and Nitric and Sulphuric Acids	Gives off little smoke	
Tonite ...	Guncotton, 50 %; Nitrate of Baryta, 50 %; and sometimes a small percentage of Charcoal	A Guncotton compound	
Ammonite ...	Ammonium-Nitrate and Nitro-Naphthaline ...	This class is the only one applicable to very fiery mines. Many experiments have shown that they will not fire coal dust or gas if proper precautions are taken. (This remark also applies to Carbonite)	Flameless Explosives.
Roburite ...	Ammonium-Nitrate and Chlorinated-Dinitro Benzol		
Bellite ...	Ammonium-Nitrate and Di-or-tri-nitro Benzol...		
Securite ...	Ammonium-Nitrate, Nitro-Dinitro Benzol ...		

This will conclude our articles on this subject, but at some future time we will deal with *firing of shots, etc.*

SINKING.

Chapter IV.

THE influx of water during sinking operations greatly increases the difficulty and cost of the undertaking. If the quantity be comparatively small, it is dealt with by winding in hoppits or water tanks, the water collecting into a hole or sump made in the centre of the shaft, the centre of the shaft being kept in advance of the sides; but the amount of water produced may be too large to be efficiently dealt with in this manner when pumps must be employed. If the strata contains a large quantity of water, which is continually running into the shaft, it would be useless to attempt to stop the flow by means of ordinary masonry, and if the water is not checked it would necessitate the employment of large pumps to keep the mine clear during the whole period of working the mine; of course, it would be useless attempting to keep back the water if it issues from the strata immediately above the mine proposed to be worked or no impervious strata occurs between them, as the water would find its way into the workings of the mine in any case. There are several methods of "tubbing" or keeping back the water. 1st—by means of timber; 2nd—by specially constructed masonry; and 3rd—by cast-iron. The best and strongest of these methods is the cast-iron tubbing, which is almost universally used; the other two methods being used to dam back smaller quantities of water. If it be decided to use tubbing, the sinking is continued through the water bearing strata until about 6ft. of the impervious bed of rock is passed through; the last 6ft. however must be at a reduced diameter so as to allow a wedging crib to be fixed on the top of the impervious rock. The shaft is sunk below this rock previous to commencing the tubbing, in order that there may be a lodge for the water during its construction. At the commencement of the impervious rock a bed is carefully prepared and a wedging crib is fixed in a similar manner as a wedging crib for brickwork, but the crib is of cast-iron instead of timber. No explosives must be used for the blasting of the rock at this point or in all probability fissures would be produced in the rock which would allow of the passage of water under the tubbing consequently rendering it useless. The wedging crib having been carefully fixed, the cast-iron segments (Fig. 2) which go to form the tubbing and which have been

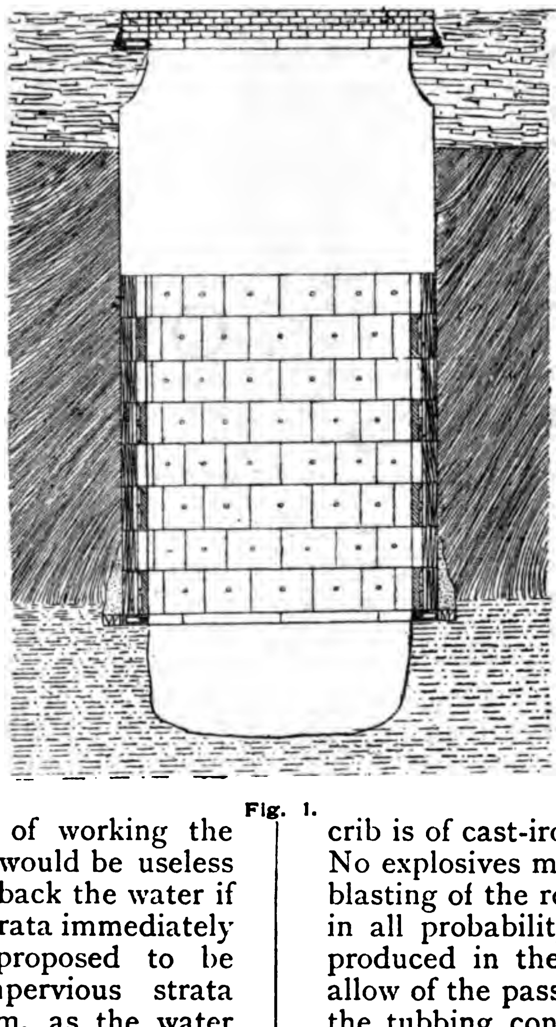


Fig. 1.

previously tested by rapping sharply with a hammer, are lowered to the bottom of the shaft. These segments are cast with flanges so as to fit accurately to each other, and with ribs fixed at right angles to the face of the tubbing to give it greater strength; a hole is also left in the centre of each segment to allow the water to escape from behind the tubbing whilst it is in course of construction. A row of segments (about 10) are fixed on the wedging crib so as to form a circle; the smooth face of the tubbing being on the inside; another row of segments are fitted on the first, care being taken to cross the joints, and so on until the wedging crib supporting the masonry is reached. Sheathings of pitch-pine are placed between all joints both vertical and horizontal, as each segment is fitted, and wedges are driven between the vertical joints to tighten them as much as possible.

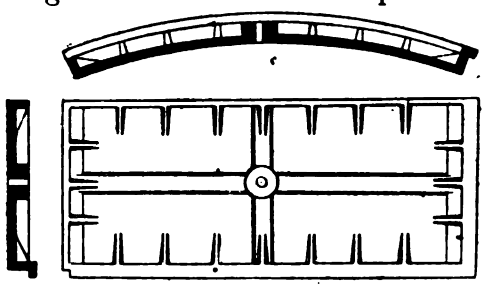


Fig. 2.

When the whole of the segments are placed in position, the wedging of the horizontal joints is commenced from the bottom upwards, the holes are afterwards plugged up in a similar manner, care being taken that this is not done too rapidly or a segment may be fractured. Sometimes a pipe is fitted into one of the upper segments to relieve the pressure if it becomes too great, the space behind the tubbing being filled with concrete as the work proceeds.

The thickness of the metal in the *tubbing* depends upon the depth of the tubbing from the surface, the diameter of the pit, and the size and shape of the segments; the metal is reduced in thickness as the tubbing approaches the surface, but ¾ inch is the minimum thickness. The following formulæ for estimating the thickness is given by Mr. Greenwell, the height of the segments being taken at 2 feet.

Let X = the required thickness in feet.
P = the pressure or vertical height in feet.
D = the diameter of pit also in feet.

$$\text{Then } X = \cdot 03 + \frac{P \times D}{50{,}000}$$

This will be the answer in feet.

(*To be continued*).

GEOLOGY.

Chapter II.

OLD lake beds are of the very greatest importance in determining details with regard to the various conditions of animal and vegetable life occurring during the period in which the lake existed. And these details do not only refer to the immediate district around the lake, because most or all lakes have one or more streams running into them, and these would certainly bring down some evidence. When the lake is in a state of calm, comparatively little action is taking place; but suppose a violent storm was to come on, every bit of a stream would become swollen and muddy. The more powerful of them will bring down trunks and branches of trees, leaves, &c., and perhaps the body of some small animal which has been washed off its feet and drowned by the rush of water; an enormous amount of matter being thus brought down in a very short time. It has been calculated that the River Reuss

deposits about seven million cubic feet of sediment into the Lake of Lucerne every year. It is at the place where a stream first enters the lake that the greatest deposits occur. It can easily be believed that the more rapid the flow of water, the greater will be the amount of solid matter able to be carried by it. When the stream comes in contact with the lake, its velocity, however great, is checked enormously; therefore the stream can no longer support all its burden. The greater part of it is at once dropped, and deposited in the bed of the lake near the side; a smaller portion will be carried further towards the middle of the lake, the distance being according to the speed of the river. Sometimes as a lake decreases or increases in extent, these sedimentary deposits will be arranged round in terraces, one above another all round. But there are also to be found in an old lake bed many deposits from the lake itself. The various shell-fish —which are common to many lakes— when they die, deposit their shells on the bottom, and in such quantities as to form a thick layer of soft white marl, which, without disturbance, may extend to a depth of very many feet. In some lakes, more especially in Sweden, deposits of peroxide of iron have been found in the form of concretions varying in size from small grains to pieces six inches across. It is supposed that the iron has been dissolved out of the adjacent rocks by water containing either carbonic acid or some other organic acids. In this state it is liable to rust, that is, to combine with oxygen. It can then no longer be held in solution, and is consequently thrown down to the bottom, where it collects in grains, which, by subsequent additions, increases largely in size. The reason for some lakes in deserts becoming so salty is that they have no outlet, and never overflow. The water which flows in evaporates and leaves all its sediment behind. The consequence is, that the water left behind becomes more and more strongly impregnated with the matter brought into it, which consists mainly of sodium chloride (common salt) and calcium sulphate.

(*To be continued*).

THE BRISTOL AND SOMERSETSHIRE COALFIELD.

THIS coalfield covers an area of about 150 square miles, and extends from Mendip Hills northward. Its greatest length is in this direction and measures 26 miles. It consists of two basins, the smaller of which is situated principally in Gloucester, and the larger in Somersetshire. They are divided from each other by a broken anticlinal which ranges in an east and west direction. On the south-west and north-east the coal measures rest upon the mountain limestone; on the east they are covered by the Bath oolites; and on the south, that is, along the northern base of the Mendip Hills, the measures assume an almost vertical position, sometimes even having a reversed dip, and the strata is of a very contorted character, not unresembling the Belgian coalfield.

A peculiar characteristic of the coalfield is that a large part of it is covered by the new red marl and lias formations, which lie unconformable on the more ancient strata, the newer formations lying almost horizontal, whilst the coal measures have a considerable dip. In all probability the

coalfield extends beyond the Mendip Hills, but there is no actual proof of this. The thickness of the strata with coal is about 6,700 feet, and the number of seams of coal contained in the coal measures are 63, but only 20 of them are above two feet thick, and these have a total of 71 feet of coal.

EXAMINATION QUESTIONS,

With Answers, by

THOS. FLETCHER, First-Class Certificated Manager

The following questions for the examination of Candidates for Certificates of Competency were set in the Lancashire and North Wales District, June, 1892.

FIRST-CLASS CERTIFICATES OF COMPETENCY.

(Continued from last issue.)

Mine Working.

QUESTION 13.—Having two workable mines within twenty-five yards of each other, which would you advise working first, with a view to safety and economy? What special precautions would you take if both mines were of a fiery character?

ANSWER.—I should work the upper seam first, or at least keep the workings in advance of the mine below. If the opposite of this was done the top mine would be expensive and bad to work. If both seams were fiery, the ventilation should be produced by a fan, and the fan shaft should be left exclusively for ventilation; the return airways should not be used for travelling roads and the men should use a good type of safety lamp.

QUESTION 14.—What are the requirements of the C.M.R.A. as to signalling—(*a*) shafts; (*b*) engine planes? Describe a system of electric signalling.

ANSWER.—The C.M.R.A. requires that—(*a*) every working shaft used for drawing minerals, or for raising or lowering persons, if over fifty yards deep, and not exempted in writing by the inspector of the district, shall have guides, and proper means of communicating distinct and definite signals from the bottom, and from every entrance in use, to the surface, and from the surface to the bottom, and to every entrance in use; (*b*) all engine planes, if exceeding thirty yards long, must have proper means of giving distinct and definite signals between the stopping places and the ends of the plane. A simple arrangement of electric signalling is to have a battery and a bell fixed at the engine-house, and two wires running along the plane. This system does not, however, permit of sending signals "in-bye;" an arrangement for accomplishing this is as follows:—A battery and bell are fixed in the engine-house, and are connected; a wire is connected to the other terminal of the battery and run along the engine plane; a second wire is fixed along the plane parallel to the first, and its "in-bye" end is connected to another bell, and to complete the circuit, the bells at each end of the plane are connected by a third wire, or an earth connection is made by means of short wires extending from each bell to the earth.

QUESTION 15.—Upon what system would you work a mine liable to spontaneous combustion, and how would you deal with a gob-fire in such a mine?

ANSWER.—A mine liable to spontaneous combustion I should work on the long-wall system, with the face advancing towards the rise. (This would have a tendency to keep the waste free from gas.) I should build the dirt into packs on each side of the road, and only leave wastes of four or five yards between the packs, and I would endeavour to have all small coal and substances likely to fire spontaneously or produce phosphorus sent out of the pit. In case a fire occurred I would if possible fill it out; failing this, I would make a road through the pack, above and below the fire, and build an air-tight wall all round, and would extinguish the fire by forcing carbonic acid through a pipe left in the brickwork. This gas I would produce from lime and hydrochloric acid.

QUESTION 16.—What are the principal duties of a fireman? How often, and when, have inspections to be made of roadways and working places?

ANSWER.—The duties of a fireman are:—To comply with the requirements of the C.M.R.A., to carry out the orders of his superiors, to see that there is always a good supply of timber, that his district is well ventilated, the airways kept clean, that all cloths, doors, &c., are in good order; fire all shots, see that the roads are of sufficient size, the roof and sides secure, timber set and drawn where required, that man-holes, signals, fences, notice and danger boards, and other requisites for safety are provided and kept in good order; that the workmen know and comply with the rules, that every one is withdrawn from dangerous places, the entrances fenced off, and no one allowed to re-enter until he again finds them safe; that

all, defects, dangers, breach of rules or discipline, or injuries, are properly dealt with and reported to his superiors.

Roadways and working places must be inspected before each shift (which must not exceed three hours before the shift begins), and during the shift, and each of the shifts, if there is no interval between them.

QUESTION 17.—In approaching an old goaf, the exact position and contents of which are unknown, what precautions would you take?

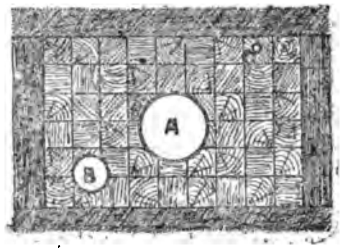
ANSWER.—If approaching an old goaf, of which the contents and exact position are not known, I would begin at where I considered to be forty yards or more from the old goaf to drive two places, about six feet wide and six yards apart, with sufficient bore-holes advancing in front and flank, and kept at least five yards ahead of the road. If a great pressure of water was expected the length of the bore-holes should be increased accordingly. The workmen should use a good type of safety lamp, and get the coal without blasting.

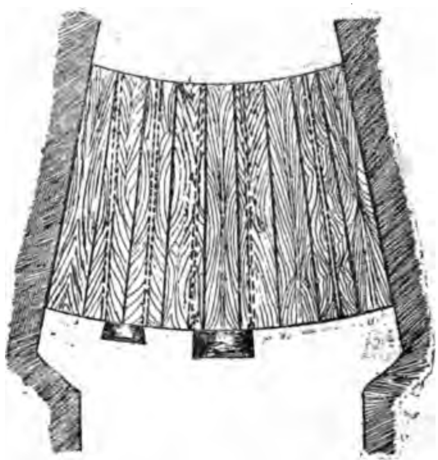
QUESTION 18.—What, in your opinion, is the best way of avoiding the risk of dust explosions underground?

ANSWER.—In my opinion, the best method of avoiding the risk of a dust explosion underground is to keep the main in-take airway (I am considering the main in-take to be the main haulage road) as clean as possible, and the far end of both intake and return swept, including roof, floor, and sides, for a length of 150 yards once every week, and for a distance of twenty yards radius, well watered, or the dust carefully removed previous to firing a shot.

QUESTION 19.—Describe and give a sketch of a dam to be put in a tunnel, eight feet by five feet, to withstand the pressure of three hundred pounds per square inch.

ANSWER.—I would make the dam of fir or oak, and choosing a convenient place in the tunnel, I would make it two feet wider and two feet higher by taking a foot of the strata from each side, roof, and floor, and taper it down on every side to its original size, in a distance of nine feet, the narrow side of the tapering being away from the water. The timbers to be made six feet long and wedge-shaped. When fitting the dam I would insert three strong iron pipes, these pipes to have taper plugs placed in them when finished. When the whole of the segments have been fitted, the joints should be made tight by inserting wedges as long as ever they can be made to enter. All timber previous to being put in should be well dried. The large pipe A is placed in the structure for the exit of the workmen. The bottom pipe B is to allow the water to escape during the construction of the dam. The small pipe C is to allow the gas to escape.





PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by October 14th, 1893.

Question 1. (E.)—Describe fully the processes by which coal is taken from the working face to the shaft.

Question 2. (E.)—State the principle of the different classes of pumps used for mine drainage.

Question 3. (E.)—How would you first proceed in searching for coal?

Question 4. (A.)—Describe with sketch the construction of some air pump designed for ventilation.

Question 5. (A.)—Describe the system and object of sinking pits under a great pressure of air.

Question 6. (A.)—How many cubic feet of water is there in a six-sided shaft 100 yards deep. The sides are each 2 feet long, and the angles contained by the side are equal?

Question 7. (H.)—Describe with sketch the construction of a gauzeless safety lamp.

Question 8. (H.)—What are the qualities required in a steam coal for navigation purposes? Where are such coals produced in the United Kingdom, and how are they prepared for sale?

Question 9. (M.)—A very high fall has occurred in a main haulage road. How would you remove the debris and re-timber the place?

Question 10. (M.)—What would you do to prevent the formation of ice in a shaft?

N.B.—Several advanced students answer the elementary questions, presumably because they are easier. We would be pleased if this was discontinued, and the elementary students receive a fair opportunity of answering them.

ANSWERS TO QUESTIONS

In No. 21.

Question 1. (E.)—Describe the methods adapted for splitting, regulating, and crossing air currents in a mine.

Answer.—The method adapted for splitting air is to allow every district a separate quantity of fresh air, and when it has been round that district to take it to the up-cast shaft direct. This is done in the following manner:—The air in coming from the down-cast shaft passes by district No. 1, the first split. Now as this is the shortest route to the up-cast, the air would rush straight to the up-cast, if it was not for the regulators being fixed in the returns to limit the supply for that district. The in-take proceeds forward to district No. 2, where it is split as above, and every district is split and regulated in the same manner until all the mine is supplied. But, as some of the districts are at one side of the in-take and some at the other, the impure air will sometimes come in contact with the in-going pure air if it was not conducted either over or under it by means of an overcast, which is made like a bridge over a canal. Brattice cloths are also used to conduct the air round the face of each district.

JOHN COOK,
28, Smithies Green,
Smitheys, near Barnsley.

Question 2. (E.)—What is a quarry, a mine, a vein, and a seam?

Answer.—A quarry is where stone is got in daylight, and open to the atmosphere. The process is to first take off the surface soil, and then work up the stone in caunches or benches.

A mine is a subterranean passage or cavity, from which mineral substances are dug or mined, the chief kind of which is coal.

A vein is a fissure in the earth's crust, most probably caused by the action of earthquakes. The fissure is filled by ores and other minerals, which are generally deposited by water.

A seam is a stratified deposit or a thin layer of rock or coal, or other substance, occurring conformably to the rocks above and beneath.

M. MOURLEY,
Rock Terrace,
Soothill Lane,
Batley, Yorks.

Question 3. (E.)—In what formations are coals found besides the coal measures? Do such coals differ from those of the Carboniferous period?

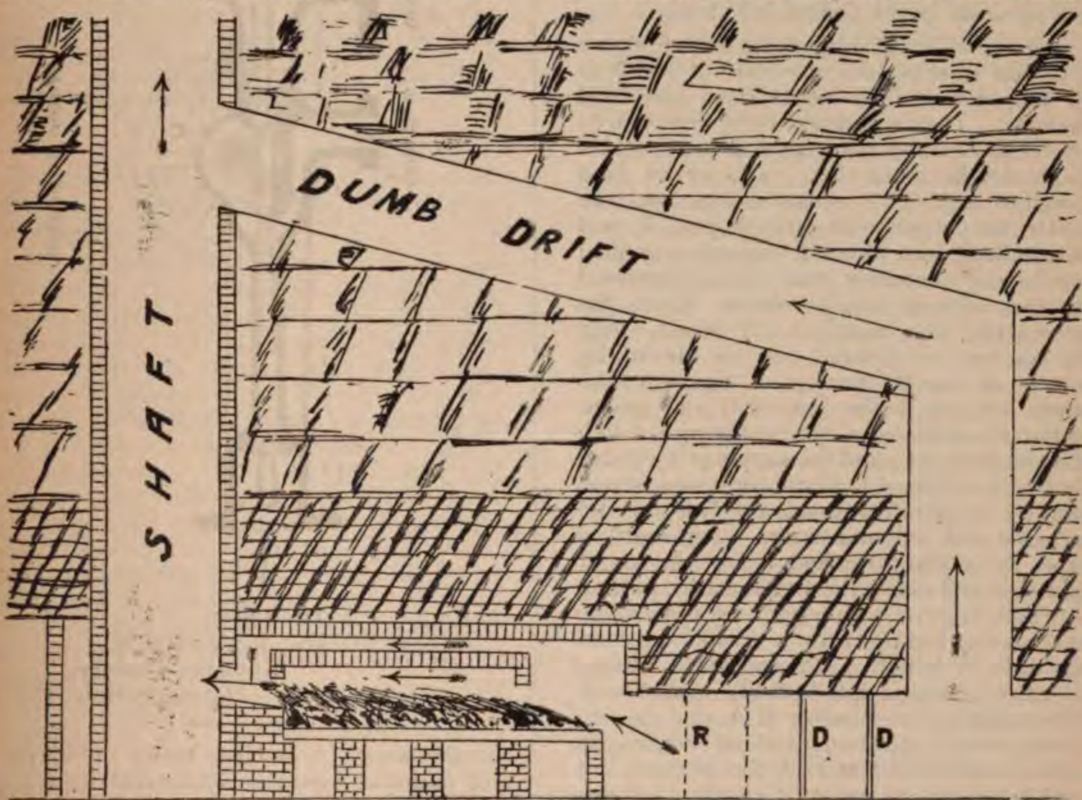
Answer.—Many coal seams are found in various parts of the globe besides those of the Carboniferous formation. The coalfields of the British Isles which are not in the Carboniferous formation are the Antracite coal seams of County Cavan, Ireland, and also those of the Isle of Man, which are found in the Silurian formation. Lignite or brown coals of Ireland, along with the Lignite beds of Bovey Tracey, in Devon, are found in the Miocene formation. Also, in Scotland and in the north and west of Northumberland, workable coal seams are found in the Carboniferous Limestone and the Millstone Grit, but the principal coal seams in England are found in the true coal measures. There is

also a small coalfield which is found in the Triassic formation at Richmond, in Virginia, United States, America. The coal is bituminous and said to be equal to the best Newcastle coal, yielding the same proportions of hydrogen and carbon, one seam being as much as forty feet in thickness. The coals found in the various formations apart from the true coal measures are as a rule of an inferior quality, being more or less of a woody nature, as is the case with the Lignites of various parts of the globe.

BENJAMIN NIGHTINGALE,
Ryhill, near Wakefield.

Question 4. (A.)—Describe, with sketch, the construction of an underground ventilating furnace, and its connection with the up-cast shaft of a fiery colliery.

Answer.—In fixing the position of an underground furnace special attention must be given to the surroundings. A furnace should be fixed either in or near the up-cast shaft where the largest volume of air can be heated by it, and it will thus produce more air than if fixed in any other place, and to fix it at the bottom of the shaft gives better results than if furnace is as much as thirty feet in length, and by a series of doors the feed is regulated according to conditions, either over or under the fire-bars. The furnace can either be fed by a safe portion of the returns, or by a current of fresh air from the downcast shaft. In a fiery colliery where the returns are foul the air is prevented from returning to the up-cast shaft over the furnace by fixing doors, and the air is led or coursed through a higher passage (the dumb drift) into the up-cast shaft at such a height above the furnace



Reference—D D Doors. R Regulator.

fixed at the top. If the furnace be on the same level as the coal it should be well isolated from it. The furnace is constructed as follows:—It is built of fire-brick, from five to ten feet wide, with fire-bars about six feet in length, above the bars from three to five feet in the form of an arch, and below the bars from three to four feet. The size of the furnace would depend upon the area of the colliery, and the amount of ventilation requisite. In many large collieries the drift as to secure the gas from firing. Size of dumb drift from eight to ten feet wide, and from ten to twelve feet high. Thus the large volumes of air circulated by these means, and the facility and certainty of its action have gained for the furnace a decided preference in many of our large collieries.

JAMES BURROWS,
103, Chapel Street,
Dalton-in-Furness.

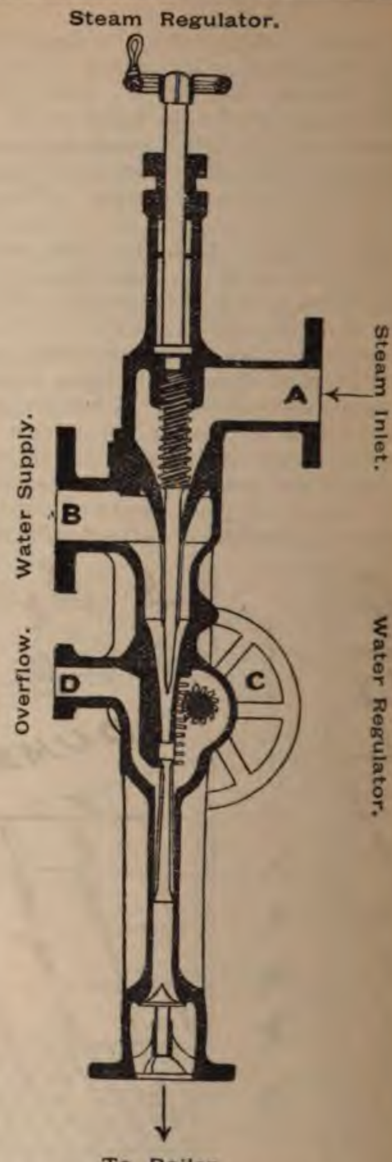
Question 5. (A.)—State what gradients, with or against the load, you would prefer for endless rope and main-and-tail rope haulage, and give your reasons.

Answer.—The gradients I would prefer would be just what would cause the system to work automatically, and this would take place if the fall with the load was about 1 in 14 for endless rope haulage. For main-and-tail rope haulage I would prefer my road to be about 1 in 100 with the load. This would about equalise the power necessary to haul the full tubs in and the empty tubs back.

JOHN. N. WARDELL,
12, West Street, Cross Lanes,
East Stanley, R.S.O.

Question 6. (A.)—Describe, with sketch, the principle of the *Giffard* Injector.

Answer.—The accompanying sketch shews a *Giffard* Injector, the chief use of which is to supply water for locomotives and land boilers. They will draw water from two to twelve feet, and for low pressures the water must not be more than 135°, or for high pressure 105° F. Steam enters from the boiler into uppermost branch pipe A and is admitted into injector through a conical nozzle, the admission steam being regulated by the vertical spindle shewn which fits accurately into nozzle, and which may be screwed as desired, up or down, by means of handle at top of figure. The water for the boiler enters B and passes round the outside of nozzle through which the steam rushes, and the supply is regulated by the hand-wheel C at the right side, which works a small pinion inside the Injector and moves a tube up and down. An overflow pipe D is also attached below the water entrance and below the Injector, the bottom of which is fitted with a back pressure valve and communicates with a check valve on the side of boiler. Having these fittings described the principle is easily understood. The steam enters Injector at A, and passing down nozzle, is condensed on coming in contact with feed water at the bottom, but without losing its velocity except that due to friction of sides. The vacuum thus formed by condensation causes more water to rush into Injector, and this water is carried by force of the condensed steam jet into the boiler. The velocity of the steam jet is certainly reduced, but not nearly so low as the jet of water issuing under the same pressure, and hence it is able to overpower and drive back the water in the boiler.



JOHN LAVERICK,
Eppleton Colliery,
Hetton-le-Hole, R.S.

Question 7. (A.)—How many cubic yar of material would be excavated from a 17 feet 6 inches in diameter, and 80 yar deep, and how much would this mater weigh ?

Answer.—The cubical contents of the may be found as follows:—The diamet squared × ·7854 × depth of pit in feet, ar divided by 27 = the cubic yards in the

Thus $\frac{17{\cdot}5^2 \times {\cdot}7854 \times 80 \times 3}{27} = 2138{\cdot}$

cubic yards. Then taking water as the standard of specific gravity, and giving the material the same specific gravity as sandstone, namely, 2·4, we arrive at the following result. The weight of 1 cubic foot of water is 62·5lbs., so that $62{\cdot}5 \times 2{\cdot}4 \times 27 = 4050$lbs. weight of 1 cubic yard of material. Then 2138·03 cubic yards × 4050lbs. = 8659021·5lbs. weight of cubical contents. As there are 2240lbs. in 1 ton $\frac{8659021{\cdot}5}{2240} = 3865{\cdot}6346$ tons nearly.

2138·03 cubic yards.
3865·6346 tons nearly.—Ans.

JOHN WARRALL,
137, Wigan Road,
Westhoughton, Lancs.

Correct answers also received from THOMAS FISHER, 37, Shrewd Hill, Barnsley Road, Nath-on-Dearne, near Rotherham; and R. CHEGWIN, The Hollow, near Crook. In a question of this kind, when the specific gravity of the strata must be guessed at, we would advise our readers to adopt 2·4 or thereabouts.—Editor.

Question 8. (H.)—What peculiar kind of locomotives have been applied for traction underground?

Answer.—Two kinds of locomotives have been applied underground, viz.:—compressed air and electric locomotives. In the compressed air locomotive, the air is used in the same manner as steam, being kept in a receiver in connection with the engine, the receiver being large enough to contain a supply of air at a sufficient pressure to last for each journey. In electric locomotives a motor is used, the motor doing the same duty as the air receiver of the compressed air locomotive. The principal objections to these methods are, that the locomotives are totally unsuited for heavy grades, and their use does not, on the whole, compare favourably with the other systems of haulage.

JOHN COWIE,
Meadowhead,
Motherwell.

Question 9. (H.)—How has electricity been applied to underground haulage?

Answer.—Electricity has been successfully applied where steam engines could not be used, as in the in-bye districts of a coal mine where steam boilers could not be fixed, or at distances to which steam could not be conveyed in pipes. Under such circumstances electrical haulage may, with advantage, be used, but for main haulage, where steam engines could be used, it would be foolish to think of applying electrical haulage. The steam engine for working an electrical dynamo may be at bank, and the energy may be transmitted from the dynamo by a cable down the shaft to the motor, which would be applied when required.

JOHN H. RONTREE,
Mapplewell,
Near Barnsley,
Yorkshire.

Question 10. (M.)—In enlarging the sectional area of a shaft, which was about 540 feet deep, and in which considerable water flowed from the sides in addition to the water which lodged in the old shaft, it was found that the water in the sump would be lost occasionally for eight or ten hours, and then return. Considerable gas was given off by the strata, and the volume of the gas given off was increased when the water was absent. What was the reason of this?

Answer.—We must remember that "air" and "mine gases" are soluble in water. It so happens that the quantity of air dissolved varies directly as the pressure to which the water is subject. The same law comprehends the whole, viz.:—The mass of air or gas dissolved is directly as the pressures and inversely as the temperatures, that is—the higher the pressure the more air is dissolved, and the higher the temperature the less of air is dissolved; and any ignorance of this law may (and has) been often attended with serious consequences to both sinkers and miners. Just to illustrate, and to make it more simple and clear, suppose a place being driven towards some old workings where there is a large accumulation of water, and this standing at high pressure in the old workings when it is tapped with bore-rods, and as the water flows off through the bore-holes the pressure is relieved, and the previously dissolved gases are set free, and many sorrowful experience testifies to the loss of life through the eliminated carbonic acid $C\ O^2$, sulphuretted hydrogen $H^2\ S$, and small quantities of marsh-gas or fire-damp $C\ H^4$. The same thing occurs in the question given.

After the water is drained out or pumped to another level, $C\ O^2$, $H^2\ S$ and fire-damp follows, given off by the strata. Water absorbs at ordinary temperatures about 4 % of its volume of atmospheric air, and in return, it dissolves a volume equal to its own of $C\ O^2$; and $C\ H^4$ is soluble to the extent of

2 % per volume, and H_2S 4 % per volume. These gases occupy the room where the water standage is in the old shaft, and when the water is absent or pumped out, they can be more easily detected than any other time, and if the ventilation is "slack" or deficient the air in the old shaft will be dangerously foul.

SAMUEL DAVIES,
New Co-op. Houses,
Mapplewell, near Barnsley.

Question 11. (M.)—How would you prepare to keep a large colliery open, in case of a pending strike?

Answer.—I would see that all packs were well up to the face within 2 or 3 feet of every drawing road, have chocks set 9 feet apart between the packs and within 2 feet from face of coal, and set two rows of props between the chocks 3 feet apart; and also props in the drawing roads commencing from the face and propping 10 yards down the road in a zig-zag form 3 feet apart. I would have all broken bars in haulage road well lined with steel bars of the same length, and the broken bars propped also until the strike was over, and then they could be taken out and the broken bars renewed. The above method was adopted in the mine at which I am employed, and I am glad to inform you that we have close upon 400 yards of a face in the Arley mine and not one place fallen up.

R. HOLCROFT,
131, Chorley Road,
Blackrod.

Question 12. (M.)—What distance from the top will the cages pass each other in a shaft of 200 yards deep, the winding being done with a drum of twelve feet diameter at the lift, and a flat rope three-quarter inch thickness?

No correct answer received.—ED.

Question 12 (M), of—No. 22.

(This question was not printed in last issue through lack of space.)

Question 12. (M.)—Can you suggest any alteration or addition to the Coal Mines Regulation Act for the proper and safe working of a colliery, and state in as brief a manner as possible the nature of such suggestions?

Answer.—1st.—In the case of general rule 4, the Act requires that in the event of three shifts working without any interval to be deemed one shift. Where a mine is worked continuously throughout the 24 hours by a succession of shifts the report of one of such inspections shall be recorded. The C.M.R.A. should be amended so that it would require a written report of the examination for every shift. 2nd.—The C.M.R.A. should require that before a person is appointed as deputy he should be the holder of a certificate of competency as deputy. 3rd.—Special rules require that if any person find fire damp or fire stink in a mine he shall report the same, before leaving the mine, to the manager, under-manager, or deputy. The C.M.R.A. requires amendment here, making it compulsory for the person finding fire damp or fire stink to report at once to the person in charge of the district. 4th.—All lamp cabins should be placed upon the surface. 5th.—Abstract of the C.M.R.A. (sec. 48) says that in the event of a fatal accident occuring at a mine, and an inquest being held, no person who is employed in that mine, or is concerned in its management, or has a personal interest in that mine is qualified to serve on the jury, &c. As it frequently happens at inquests that the jury are composed of local tradesmen and other persons whose knowledge of the practical working of collieries may be said to be nil, and as various questions are frequently raised concerning liability and negligence, the C.M.R.A. should be amended so that at least one practical working miner would be allowed to sit upon a jury.

THOMAS BEST,
Railway Street,
Tow Law,
Co. Durham.

ANSWERS TO CORRESPONDENTS.

R. T. (Wigan).—We will make enquiries for what you require, and will let you know in next issue.

S. T. and many others.—We offer you our best thanks for the trouble taken to furnish us with the names and particulars of Mining Schools, and we have forwarded specimen copies to them. Now is the time for readers to help us to increase our circulation, when the various schools are about to commence the session. If, as one of our well-wishers recently remarked, each reader could induce a friend to become a subscriber—and this is a very easy matter to do—our circulation would be doubled.

COMPETITOR.—Will forward with next prizes, if any. Yes.—To forward first twelve numbers, will cost you one shilling.

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MINING

A Journal devoted to the interests of Mining.

No. 24. Vol. I. October 19, 1893. FORTNIGHTLY ONE PENNY.

CONTENTS.

HEAT.—By Calor.

Chapter VII.

The Pressure of the Atmosphere.

PRIOR to the time of Toricelli, the pupil of the great Galileo, the action of the common lift pump was not understood. It was the universal belief that the water which filled the vacuum created by the pump bucket was *drawn* in, and the people of this period explained this fact by saying that nature abhors a vacuum. Galileo, however, conceived the idea that the atmosphere exerted the pressure on the surface of the water which forced it up the pipes. Toricelli, proved the truth of this theory by the following experiment. He obtained a glass tube (fig. 7) over thirty inches in length, closed at one end, and fitted with a uniform bore. This he filled with mercury (quicksilver), and placing his thumb over the open end of the tube to prevent the mercury running out, inverted it into a dish partly filled with mercury (fig. 8), and then removed his thumb. The mercury lowered in the tube for a short distance and finally settled in a certain position, and by measurement he found that the height of the mercury in the tube above the surface of that in the dish was thirty inches, and from this he calculated the weight of the atmosphere.

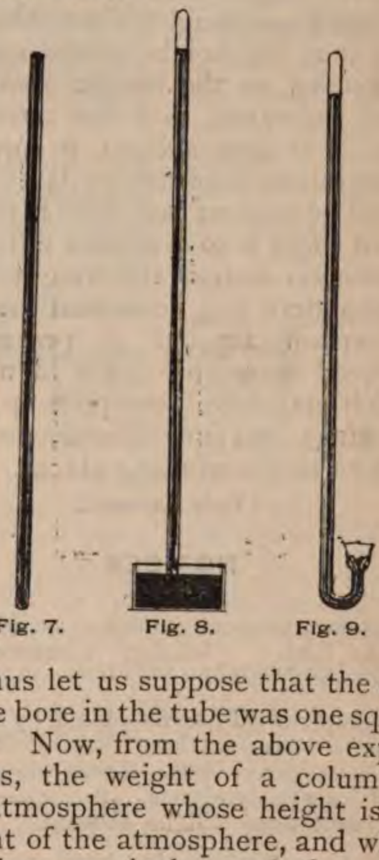


Fig. 7. Fig. 8. Fig. 9.

Thus let us suppose that the area of the bore in the tube was one square inch. Now, from the above experiments, the weight of a column of the atmosphere whose height is the height of the atmosphere, and whose base is one sq. inch, equals the weight of a column of mercury thirty inches high and one square inch at the base, *i.e.*—thirty cubic inches of mercury. One cubic inch of mercury weighs

0·49 pounds ∴ the pressure of the atmosphere = 30 × 0·49 pounds = 14·7 pounds per square inch.

From this we see that TORICELLI by this experiment invented the *barometer* in its simplest form. Fig. 9 shows the barometer as at present constructed, the dish of mercury being replaced by having the tube bent and a cup formed on its short side, the height of the mercury being in this case regarded as the difference in height between the two columns.

PASCAL, by subsequent experiments with TORICELLI's instrument, found that the height of the mercury varied with different heights above sea level, and that the height of the mercury decreased as the height above sea level increased, and *vice versa*, and that it is also subject to ordinary fluctuations from day to day. Now it will be evident that what is implied when there is said to be a fall in the barometer is that the weight of the atmosphere has decreased and that a certain amount of pressure is relieved from the gases in a mine which may have been pent up in old workings, and consequently the gases escape to the working places.

(*To be continued.*)

NOTICES.

Literary communications to be addressed to the Editor, "Mining," Clarence Yard, Wallgate, Wigan.

Agents would greatly oblige by sending in their orders not later than the Monday preceding day of issue. If they will give this their earnest attention, all inconvenience and annoyance will be avoided.

All correspondence for publication can be sent at book post rates, providing the ends of the envelope or package are left open for inspection. All business communications should be addressed to STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by October 28th, 1893.

Question 1. (E.)—Explain with diagrams a trough fault, inverted strata, and inlier.

Question 2. (E.)—State the form, weight, and best mode of laying underground rails.

Question 3. (E.)—State exactly the inclination or gradient (assigning reason for it) which should be given to the main levels of collieries.

Question 4. (A.)—How has the ventilation of a mine been produced by falling water.?

Question 5. (A.)—What do you know about ascentional ventilation?

Question 6. (A.)—Describe the Hepplewhite Gray's deputy lamp.

Question 7. (H.)—What quantity of coal dust do you consider would accumulate in a main haulage road twelve feet by six feet, in a dry and dusty mine, through which five hundred tons of coal are drawn daily?

Question 8. (H.)—How is the air through a mine affected by friction?

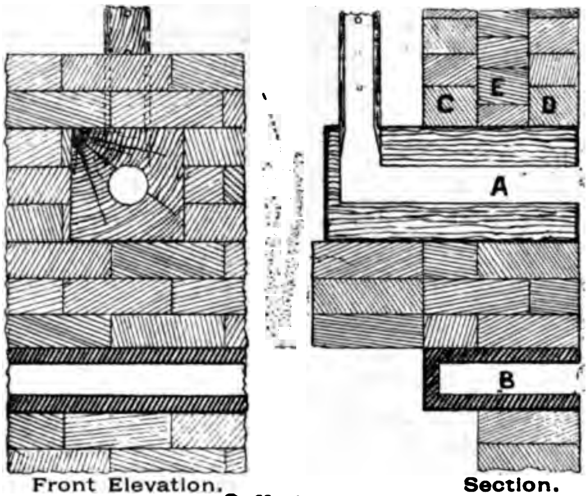
Question 9. (M.)—Explain what would occur if a mine giving off much gas was worked by longwall, with the face advancing towards the dip.

Question 10. (M.)—Describe in a general way how you would ventilate a colliery, and state under what conditions the fan, furnace, or natural ventilation could be most advantageously employed with respect to volume and cost of air produced.

SINKING.

CHAPTER V.

THE damming back of water in the shaft, whilst the sinking is in progress, with specially prepared masonry is known as coffering. The preparation for the masonry is made in a similar manner to that for the cast-iron tubbing described in a previous article, viz:—The water feeding strata being passed through, and the sinking continued until an impervious bed of rock is reached. Upon this is fixed an ordinary wedging crib (B) fourteen inches in the bed and six inches deep. A wall is then built upon this about nine inches high, to act as a foundation for the coffering proper, and upon this the plug-boxes (A) are placed.



Front Elevation. Coffering. Section.

If some means were not adopted to prevent the water from running over the brickwork as it is constructed, the mortar would be soon washed away. Plug-boxes are therefore inserted at intervals round the shaft about six in number. These are formed in the following manner:—A piece of timber twenty-one inches by nine by ten inches is procured and a hole three inches in diameter is bored along its long axis to within an inch or two of the back, *i.e.*, the hole is bored to a depth of nineteen or twenty inches. Another hole of the same diameter is then bored vertically from the top of the block to the end of the first hole. In the vertical hole wooden pipes provided with small holes on each side, about every three inches, are fixed and carried up behind the brickwork. The water passes through the holes into the pipes while the walling is being built, and when it is about a foot high the holes are plugged up to a level with the brickwork with small pegs, and the space around the pipe is filled with clay or well riddled black soil. The water then forces its way through the next higher series of holes. The plug-boxes being fixed in position on the foundation wall round the shaft, the walling is built up between them to the same level, and then the building of the special set masonry commences. This consists of three or five rings of header bricks, which are laid in the following manner:—If it be decided to build the coffering of three rings (as shewn in sketch) the two outside rings (C and D) are laid with headers, and about four courses are built. The space left between the two rings is about five-and-a-half inches, into which liquid cement is poured, and a course of bricks one-and-a-half inches thick are dropped. The one-and-a-half-inch bricks are only used for the first course, the object being to cross all joints in the brickwork, both vertical and horizontal. After the first course has been laid three courses of ordinary bricks are dropped in. The hole in the water pipe is plugged up to the same height, and the space round the pipe is well filled in with puddle. This process is

repeated until the coffering is carried to the surface, or to the wedging crib above the water-bearing strata.

When the water-bearing strata is of great thickness it may be necessary to protect the sides of the excavation until the impervious rock is reached. An arrangement which has been successfully applied to overcome the difficulty, is to make the diameter of the shaft two feet wider than would be necessary for the ordinary coffering and to fix wooden wedging cribs at intervals of six feet. The cribs are suspended one from another, and the top one from baulks of timber laid across the pit at the surface by stringing deals, and the sides are protected by a wall of dry bricks laid on the cribs.

(*To be continued.*)

MECHANICS.

The Lever.

A LEVER is defined as a rigid rod in which there is a fixed point or axis, about which it is capable of turning. This fixed point is called the *fulcrum* of the lever, and those parts of the bar on either side of the fulcrum are called the *arms*.

There are three different kinds of levers, according to the position of the fulcrum, with respect to the weight and power.

When the weight to be raised, or resistance to be overcome, is situated at one side of the fulcrum of the lever, and the power to raise the weight, or overcome the resistance, is applied on the other side, the lever is of the *first* kind. Thus a crowbar employed to raise a stone is a lever of the first description.

In the lever of the *second* kind both the weight and the power act on the same side of the fulcrum, the weight being nearest to it. A wheel-barrow is an example of this kind. The centre of the wheel is the fulcrum, the handles the position at which the power is applied, and the weight acts at the centre of gravity of the load which is situated between the wheel and the handles, *i.e.*, between the fulcrum and the power.

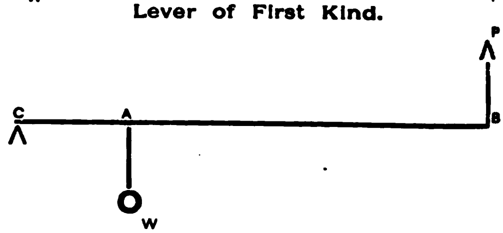
In the *third* kind the weight and power are again on one side of the fulcrum, but their position are exactly opposite to that in the second kind, the weight being furthest away from the fulcrum.

Now, in all three cases, the power necessary to raise a definite weight, according to the conditions given, may be found by the following formula:—

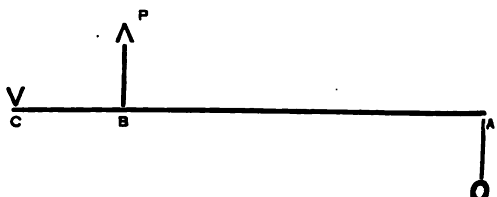
$$P \times BC = W \times AC$$

or, the power × its arm = weight × its arm.

Lever of First Kind.



Lever of Second Kind.



Lever of Third Kind.

References:—AC Arm of Weight. W Weight. C Fulcrum. BC Arm of Power P Power.

From this we see that by me[ans] of a lever two forces, however uneq[ual] may, by adjusting the position of fulcrum, be made to balance,

that a mechanical advantage or disadvantage is produced by having B C greater or less than A C.

In 1st, the pressure on the fulcrum is P × W acting downward.

In 2nd, the pressure on the fulcrum is W — P acting downward.

In 3rd, the pressure on the fulcrum is P — W acting upward.

To illustrate these principles more clearly we will take a few simple examples, the weight of the bar being neglected.

EXAMPLE OF LEVER OF FIRST KIND.

A crowbar employed to raise a weight of one ton is six feet long, and the fulcrum of the bar is one foot from the weight. What power must be applied at the other end of the bar to to raise the weight?

$$1 \text{ ton} = 2240 \text{ lbs.} \quad P \times 5 = 2240 \times 1$$

$$P = \frac{2240}{5} = \underline{\underline{448 \text{ lbs}}}.$$

i.e., a pressure equal to 448 pounds must be exerted on the end of the longer arm of the lever in order to raise the weight.

EXAMPLE OF LEVER OF SECOND KIND.

What force must be applied at one end of a bar twelve inches long to raise a weight of thirty pounds, hanging four inches from the fulcrum which is at the other end, and what is the pressure on the fulcrum?

$$P \times 12 = 4 \times 30. \quad P = \frac{120}{12} = \underline{\underline{10 \text{ lbs.}}}$$

The pressure on the fulcrum will of course be 30 — 10 = 20lbs., for the power is acting in a different direction to the weight.

EXAMPLE OF LEVER OF THIRD KIND.

A weight of ten ounces at the end of a lever is raised by a force which is just greater than thirty-six ounces, and which acts six inches from the fulcrum which is at the other end; what is the length of the lever?

$$AC \times 10 = 6 \times 36. \quad 10AC = 216.$$

$$AC = \underline{\underline{21{\cdot}6 \text{ inches.}}}$$

In the lever of the first kind a mechanical advantage or disadvantage may be produced according to the position of C. In the lever of the second kind a mechanical advantage is always gained, as the weight arm is always shorter than the power arm. In the lever of the third kind, there is always a mechanical disadvantage, it being *vice versa* to the second kind. Now, although a mechanical advantage may be gained by the conditions stated, yet it must not be considered that this advantage is gained without sacrificing something. Let us again have recourse to example 1 to explain what is lost. By this example we found that 448lbs. at one end of the bar lifted five times its weight at the other; but suppose the 448lbs. travels downward to a distance of 5 feet, then the ton weight will only be raised one foot, and we see that speed or distance has been lost, although a mechanical advantage has been gained. In the animal frame several examples of levers of the third kind are found where readiness of action is gained at the expense of power.

EXAMINATION QUESTIONS,

With Answers, by

THOS. FLETCHER, First-Class Certificated Manager

The following questions for the examination of Candidates for Certificates of Competency were set in the Lancashire and North Wales District, June, 1892.

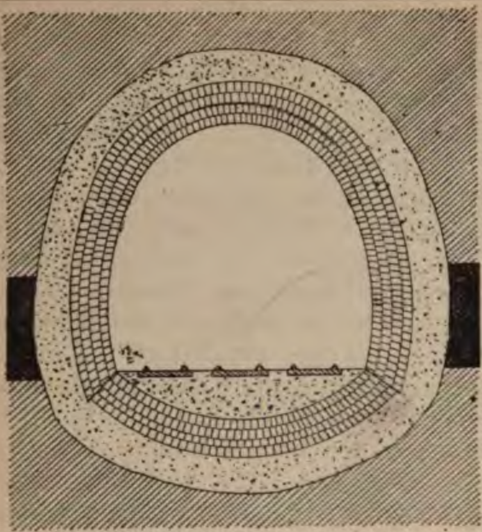
FIRST-CLASS CERTIFICATES OF COMPETENCY.

Commenced in No. 22.

Timbering.

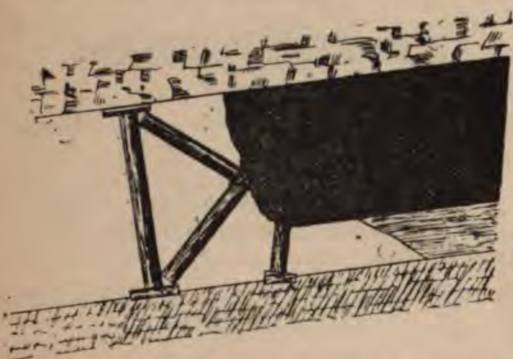
QUESTION 20.—State the method by which you would permanently secure the pit-eye of an important winding shaft sixteen feet diameter, where you expect to raise six hundred tons a day, hooking-on at both sides of the shaft, the roof and warrant of the mine being of a treacherous nature.

ANSWER.—I would construct a strong horse-shoe arch, preferably of stone, with an inverted arch below.—(*See sketch.*)



QUESTION 21.—Describe by a sketch how you would set sprags in a mine four feet thick, working long-wall, up-brow rising one in five, where the holing dirt is eighteen inches thick, and the bottom floor soft. What distance apart should the sprags be set?

ANSWER.—The sprags should be set six feet apart, with good foot blocks at the bottom, and tightened by a wedge. Midway between the sprags cocker-megs should be set as an extra precaution.



QUESTION 22.—What sort and thickness of bar timber would you use for a roadway twelve feet wide, six feet high, in a mine with a bad roof, six hundred yards deep from the surface? Give a sketch of the way you would set the bars.

ANSWER.—I should use bars of larch at least a foot thick, supported by props nine inches diameter, fixed, as shewn in sketch, at intervals of about two feet along the roadway, with two-inch planks as stretchers from bar to bar. But in my opinion metal bars would be preferable under such circumstances.

Surveying.

QUESTION 23.—You have to drive a tunnel for a waterway to meet a roadway between two shafts, and have no reliable plan. How would you proceed?

ANSWER.—I would make a survey of the shafts and plot them on a new plan, and on this I would mark the bearing of the proposed tunnel.

QUESTION 24.—State what it is necessary to observe with regard to colliery plans.

ANSWER.—The C.M.R.A. requires that they be accurate, and must show the workings up to date not more than three months previous, the general direction and rate of dip of strata, together with a section of the strata sunk through, or a statement of the depth of the shaft with a section of the seam; also the scale of the plans must not be less than twenty-five inches to a mile.

QUESTION 25.—What instrument would you use for a very important underground survey? State what precautions you would take to secure the accuracy of your work.

ANSWER.—I would use a transit theodolite, and unless I was certain that the stations near the proposed survey were correct, I would survey from the shaft, and if practicable tie in to another shaft. I would take several loose-needle bearings to check it, and when doing so would take care that no substance likely to attract the needle was in close proximity to it.

(To be continued.)

Coal-gas contains hydrogen and carbon. When it burns these elements combine with the oxygen of the atmosphere, forming respectively water and carbonic acid gas.

GLOSSARY OF MINING TERMS

(NORTHUMBERLAND)

COMMUNICATED.

After-damp.—A poisonous gas composed of carbonic acid gas, watery vapour and nitrogen. It results from the explosion of fire-damp.

Agent.—The direct representative of the colliery owners.

Air-crossing.—A bridge over an airway for the purpose of passing a current of foul air over a current of fresh air.

Air-pipes.—Wooden or zinc pipes used for conveying a supply of fresh air into a working-place.

Auger.—A tool for boring holes in wood, such as sleepers.

Axe.—A tool for chopping wood, used by timber setters and deputies for drawing.

Back.—A vertical joint in the coal containing clay or white spar.

Back-end.—The last shot taken off each time across a bord.

Back-shift.—The second shift where there are two shifts in one day.

Back-overman.—The second overman or overlooker, who enters the mine when the fore-overman or under-manager leaves.

Backing-dales.—Wood dales used behind the cribs in a sinking shaft to support the sides of the shaft.

Badger-coal.—Impure coal: a mixture of stone and coal.

Baff-ends.—Stays placed behind metal tubbing to prevent it from shifting when being fixed.

Baff-Saturday.—The Saturday on which the pits work, not being the pay day.

Balks.—Heavy timber for supporting the roof, &c., in the main haulage roads.

Band.—A layer of stone or slate in the coal.

Bank-head.—The top of an incline.

Banksman.—The person who loads and unloads the cage at the surface and attends to the rapper.

Bargain.—A contract agreed on by the manager and the workmen by competition.

Barrow-way.—The haulage roads from the working-places to the flat.

Beater.—A tool for stemming a hole after being charged with an explosive.

Billie-fair-play.—A system of weighing the small coal which has passed through the screen and deducting it from the total weight of coal in the tub.

Bitch.—A tool for extracting broken boring rods.

Blasting or Shutting.—The operation of forcing up or down coal or stone by an explosion.

Blocking.—A method of chopping down the coal to make height for the curving or holing.

Bottoms.—The coal that is blocked down while curving.

Bottom-canch.—A cutting in the bottom stone of a working-place to make height.

Bracehead.—A handle for turning bore rods.

Brakesman.—The person in charge of the winding engine.

Branches.—The various rail-roads about the pit, at the surface.

Branchman.—The person who drives the branch-horse.

Branch-horse.—The horse used for hauling the wagons about the branches.

Brasses.—Pieces of hard rock embedded in the coal, composed of iron and sulphur or some other substance.

Brattice.—A partition to form two compartments for passing air up one side and down the other.

Broken.—The system of taking out the pillars.

Broken-jud.—Taking out a pillar of coal in one lift.

Brushing.—The work of shutting top and bottom canches in the workings.

Buck.—A small wagon for conveying stone in a mine.

Bucket.—A hollow piston with valves which open upward for lifting water in a pump set.

Bucket-door.—The entrance in the working barrel to the bucket.

Bucking.—The conveying of stones to the stow-bord.

Butt.—The first piece of packing to form a new gateway.

(*To be continued.*)

ANSWERS TO QUESTIONS
In No. 22.

Question 1. (E.)—How do you account for the cleavage of shale and slate?

Answer.—Various rocks are affected by cleavage, though most of them are at great depth, and therefore they must be very old. Such a class of rock is the metamorphosed clay-slate used for roofing. In clay-slate the rock splits up into thin laminæ so well known, each line of cleavage being parallel with that above and below it, and of equal thickness. It is then clear that one agent at work in its formation is intense compression, with a sliding motion of the particles composing the rocks (shales) and slates, as in the coarser-grained rocks such as sandstones, this sliding motion can be easily seen by the pebbles being worn flat in the planes of cleavage. Still there is a possibility of heat having had a hand in helping the mechanical forces which have been at work in the earth's crust to form the planes of cleavage now found in shales and slates.

JOHN COOK.
28, Smithy Green,
Smithies,
near Barnsley.

Question 2. (E.)—Explain the term vacuum.

Answer.—Vacuum is an enclosed space from which the air or any other matter has been exhausted. If I take a glass closed at one end, about forty inches in length, and fill it with mercury, then invert the open end in a bowl filled with similar liquid, the mercury will settle near the top of the glass tube. Now the difference between the level of the mercury in the tube and that in the bowl is about thirty inches. This column of mercury is held up by the pressure of the atmosphere upon the surface of the mercury in the bowl. When the mercury descends in the tube it leaves a space at the top, which is known as a vacuum, as there is nothing in it, comparatively speaking, though a perfect vacuum cannot be obtained.

JAMES FINCH,
Green Lane,
Hindley Green,
near Wigan.

Question 3. (E.)—What is the object of mine ventilation?

Answer.—The objects of mine ventilation are:—To supply constantly an adequate amount of air (pure air) throughout the galleries of a mine for the respiration of men and animals and for the combustion of lights, to dilute and render harmless the noxious gases given off by the working of the mine and in that diluted state remove and carry them away as quickly as produced—in short, the chief object of mine ventilation is to have a constant exchange of fresh air for foul.

G. A. HAWES,
Holy Trinity Terrace,
Murton Colliery,
Durham.

Question 4. (A.)—What is meant by the negative load of a winding engine, and how is it counteracted?

Answer.—Negative load occurs in bringing a full cage to bank when the unequal weights of the two ropes are not counterbalanced by the weight of the coals. This is prevented by adopting one of the systems of counterbalancing such as the pendulum balance, chain and staple, scroll drum, or *Koepe's* tail rope. The *Koepe's* tail rope is a cheap, suitable, and effective arrangement, and it may be understood by saying that an old pit rope is attached to the bottom of the cage at bank and is carried down the shaft and round a loaded pulley moving in guides, to constantly keep a uniform tension on the rope, and the rope-end is then attached to the bottom of the cage at the bottom of the shaft. By this means an equality is established in the weights of the ropes attached to the two cages.

JAMES R. ALLOTT,
Fitzwilliam Hemsworth Colliery,
Hewsworth,
near Wakefield.

Question 5. (A.)—How would you ventilate a tunnel which is being driven singly several hundred yards?

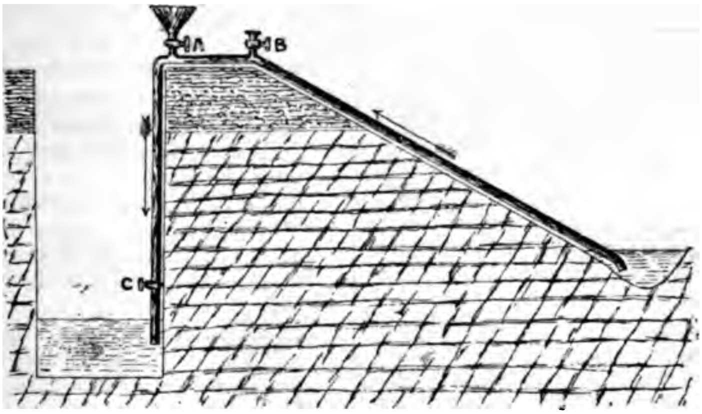
Answer.—The mode of ventilation would depend on the quantity of gas given off. A simple plan would be to have a canvass brattice nailed to vertical posts or props along the centre of the tunnel. Another plan is to have sheet iron tubes from ten to thirty inches diameter fixed along the side of the tunnel. A more effective plan would be to have a good brick walling, nine inches thick, which can be made perfectly air-tight (which is of great importance). having the wide side for the intake and the narrow side for the return. The brick walling also serves as a support for the roof, and care must be taken

to keep the walling a sufficient distance from the forebreast, especially if shot-firing is carried on. The wall is usually connected up to the forebreast by a canvass brattice.

JAMES BURROWS,
103, Chapel Street,
Dalton-in-Furness.

Question 6. (A.)—Describe, with sketch, the action of a syphon.

Answer.—The sketch is an illustration showing the principle of the syphon. The in-take end of the pipe is seen on the right hand side of sketch. The pipe ascends to the top of a slight elevation, and then descends below the surface of the in-take water. The in-take end of the pipe is fitted with a self-acting valve which will only open to admit water, and the delivery is provided with a tap (C) which is shut during the process of filling the pipes with a solid column of water. The funnel (A) is used for pouring the water into the pipes, and the cock (B) allows the air to escape from the pipes while this is being done. When the water overflows at B the taps A and B are closed and the tap C is opened, when the water flows in the direction of the arrows. The height from the level of the in-take water to the highest point to which the water ascends is known as the altitude, and the difference in height between the intake and the delivery water is called the motive column. Now, water should ascend to a height of thirty-four feet, but in order to obtain a flow and allow a little pressure to overcome friction and the lifting of the valve at the in-take end, the



altitude should never exceed twenty feet, and the delivery pipe should have thirty-four feet vertical height. The delivery end of the pipe should be immersed in water or slightly turned up to prevent air from gurgling up the pipes.

BENJAMIN NIGHTINGALE,
Ryhill,
near Wakefield.

Question 7. (H.)—Describe the endless rope method of haulage.

Answer.—For the endless rope system of haulage a double way is required, the full tubs going out on one side and the empty tubs returning to the workings on the other side. It is better described as an endless band or rope passing round the drum of the engine, up one side of the road, round a pulley or return wheel, and back along the other side of the road to the engine. The tubs are fastened to the rope by means of clips (see figures 1 and 2) and

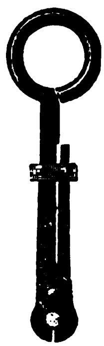


Fig. 1.

Fig. 2.

are about twenty yards apart. Where there are large branch haulage roads (as there generally are), the main rope only goes so far, and terminates on a pulley as before. Then another endless rope is used, passing round a pulley driven by the main pulley, and in this manner the main rope can be made to drive five or six branch ropes all delivering on to the main engine plane, and the coals are all finally hauled out by the main rope which travels at the rate of about three miles per hour.

THOMAS MORDY,
Cross Lanes,
Hetton-le-Hole, R.S.O.

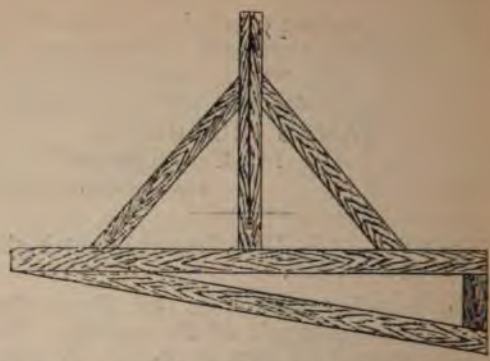
Question 8. (H.)—Having a pit 300 yards deep, state size of pillars you would leave to protect it. State also the chief considerations that would guide you to determine this.

Answer.—To be able to determine this would require very careful consideration, for a shaft's pillar at one colliery might not answer at another, so it does not do to have a fixed rule. For shafts of three hundred yards I would recommend from seventy to one hundred yards square to be left. But before I determined the size I would be guided by the following:—1st, Nature of strata sunk through; 2nd, Dip of strata; 3rd, Thickness of coal; 4th, Strength of coal; 5th, Nature of roof and floor. A good simple rule for the size of the side of the shaft pillar is given by Mr. Greenwell, viz.:—One-quarter the depth from the surface. In this case it would be $300 \div 4 = \underline{75 \text{ yards}}$.

WILLIAM PILKINGTON,
324, Church Street,
Westhoughton,
near Bolton.

Question 9. (M.)—How would you keep a tunnel straight in a given direction, and how would you keep it at a given inclination?

Answer.—A tunnel may be kept straight and in a given direction by the use of the miner's compass or the theodolite, and by the use of plumb-lines suspended from the roof. A compass or theodolite is set in the centre of the tunnel, the head of the instrument pointing in the exact direction which it is intended to drive. Two or three plumb-lines are then suspended from the roof at intervals of two or three yards in the line of direction of the drift. The observer stands behind the plumb-lines, and another person stands at the face of the tunnel with a light. When the lines come to rest a sight is taken, and



the light at the face brought into a line with the plumbs. This line indicates the direction of the tunnel, and the light at the face should give the centre of the tunnel.

To keep a tunnel at a given inclination, a wood level or plumb-bob (see sketch) is constructed, with a foot-piece set at an angle with the vertical piece corresponding to the angle of inclination required in the tunnel. When the tunnel is proceeding at the proper angle, the top part of the plumb-bob is level and the bob hangs in the centre. The figure represents the level necessary for an inclination of one in six, the length of the main horizontal piece being six feet, and the distance from the bottom of this piece to the bottom of the inclined piece being one foot.

SAMUEL THORPE,
Cheviot View,
Ryhill, Wakefield.

Question 10. (M.)—What do you consider to be the reason of more falls of roof occurring during the night than in the day?

Answer.—The following may be the cause:—During the day the air of the mine contains a large amount of watery vapour which, in the evening when the air is at a lower temperature, condenses on the roof and sides of the roadways, and the watery vapour causes the strata to crack and smoulder, and in a very short time it will fall. This action is much greater in summer than winter, and greater in shallow mines than deep ones. The fact is easily explained, the air being more rarefied in the day by reason of the solar heat, and consequently holding more moisture in solution, comes in contact with the strata and becomes condensed.

ALBERT HART,
173, Kiveton, Park,
near Sheffield.

METAL MINING.

OUR Journal being principally devoted to the interest of the coal mining student, we do not propose to go very deeply into metal mining, but, as a student sitting for a South Kensington Science and Art Examination, must be more or less versed in the preliminaries of metal mining, as it is the same paper that is set for the metal mining as the coal mining student, we consider it our duty to assist such students by at least inserting a few articles on Elementary Metal Mining. Independent of the above Examinations, it will be to the advantages of every person connected with mining of any description, to have a slight knowledge of the methods of working in metal mines.

UNDER AND OVERHAND STOPING.

The student must first impress upon his mind that whereas coal seams are comparatively flat or horizontal, mineral veins nearly always approach the vertical; levels are driven on each side of the shaft at distances apart of about twenty yards; these levels are thus cut *one above the other*, and are connected at intervals for purposes of ventilation, etc., by small shafts or winzes. In this manner the whole of the lode to be worked is cut into blocks similar to the pillar in coal mining. The removal of the ore between the levels is carried on by what is known as "stoping," of which there are two entirely different methods, named respectively "Underhand" and "Overhand."

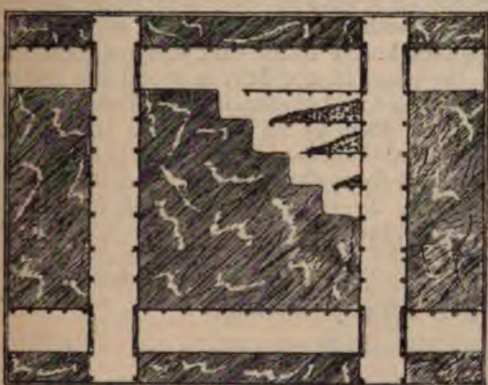


Fig 1.

In underhand stoping (Fig 1) the ore is worked downward from the upper level to the one below; a caunce 5 or 6 feet deep and a suitable width according to the size of the road is commenced at the upper corner of the pillar, and is worked across in a horizontal direction towards the next winze; immediately this caunce has gone a few yards another is commenced below, and so on until the whole of the pillar is being worked out in the direction of the next winze, each caunce being slightly in advance of the one below, which gives the unworked portion the appearance of a huge staircase. The useful mineral is separated from the deads, and is then taken out through the level next below; the deads are stowed away on platforms above the miners heads, or are taken out with the minerals.

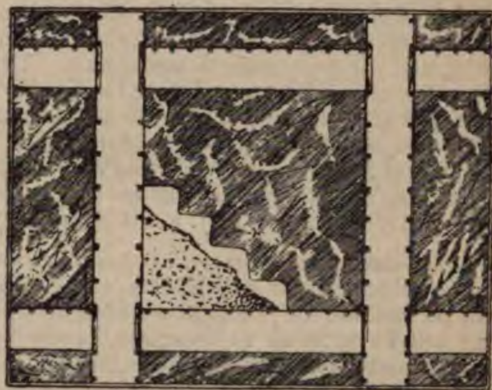


Fig 2.

In overhand stoping (Fig 2) the process is exactly opposite. The caunce is commenced from one of the lower corners of the pillar, another commencing above after it has gone a few yards, and so on as previously described. The men either stand upon "platforms" or "stalls" or upon the deads which are thrown behind them and are supported by the timbering of the roof of the bottom level. A passage is left through the deads to allow the ore to be passed through to the level below.

The overhand method is the most economical, the amount of timber required not being nearly so much as in the other method, although the ore is not so cheaply got, nor can as many men be employed.

The "*fur*" deposited on kettles and boilers is a carbonate of lime, formed by the expulsion of the dissolved carbonic acid gas which enabled the water to dissolve the carbonate.

Qualifications of Candidates
FOR
MINE-MANAGERS' CERTIFICATES.

MANCHESTER AND IRELAND.

Each candidate must be twenty-one years of age. He must have had five years' practical and other experience in a mine, subject to the Coal Mines Regulation Act, 1887, and he must be able to read and write.

First-Class Certificates.—1. Arithmetic, including vulgar and decimal fractions. 2. The knowledge necessary for the practical working of collieries and other mines under the Act in the North and East Lancashire or Manchester district including all the provisions of the Coal Mines Regulation Act, 1887, and the principles of mechanics. The attention of candidates is directed to *Goodeve's Principles of Mechanics*, or other text-book on the same subject (probably in future *Tate's Elements of Mechanics*). 3. *A Practical Treatise on the Gases met with in Coalmines and the General Principles of Ventilation*, by J. J. Atkinson, Esq.

Second-class Certificates.—The examination and qualification for second-class certificates will be suitable for practical working miners, and will be such as to ascertain, partly by written and partly by oral examination, the knowledge necessary for the practical working of mines in this district. The following will be the heads under which the examination will be held:—1. Reading, writing and arithmetic—first four rules. 2. Knowledge of the Coal Mines Regulation Act, 1887, and the special rules in force in this district. 3. The various systems of working coal. 4. Mode of sinking, working, timbering, bratticing, and ventilation.

To find depth of a pit by means of the Barometer:—

Reading at the top	29·6
Reading at the bottom	29·9

$$29{\cdot}6 + 29{\cdot}9 = 59{\cdot}5$$
$$29{\cdot}9 - 29{\cdot}6 = {\cdot}3$$

Multiply difference by 55,000 and divide by the addition, as

$$55{,}000 \times {\cdot}3 \div 59{\cdot}5 =$$

277 feet, depth of pit.

CORRESPONDENCE.

Newcastle-on-Tyne,
11th October, 1893.

Dear Sir,

In your last issue, No. 23, I see one of your Correspondents offers some suggestions of alterations or amendments to the C.M.R.A. Now I think he must not know General Rule 4, nor ever practised as deputy, for he suggests that a written report of every examination should be made. I should like to know where he has been that this was not done; evidently he has not attained to the responsible position of deputy yet, or he would know that a report of each shift or examination was made and signed by the person who made the examination. Also he suggests that a person should hold a certificate of competency as deputy. Does he mean a Science Class Certificate or what? because every man who practises as a deputy must hold an authorisation from the manager to carry out the rules and work of a deputy, and in my opinion Mr. BEST will be aware that a manager is not going to choose any body that is likely to be incompetent or negligent. Again, I think that if Mr. BEST was at any colliery, where fire-damp was found, he would soon see that it was reported to the deputy then in charge.

Evidently Mr. BEST has never been at an inquest, or he would know that the manager, and often the undermanager or overman, were present, besides the inspector, to watch the proceedings. I used to think the same myself once, but after having been at one or two inquests I think it is better that no practical working miners are allowed to be on the jury, because they may be prejudiced to the methods of working, or some of the officials, and I think that when a good plan of the place of accident is produced, and all particulars and evidence taken before a jury of such men as he calls local tradesmen, they can then decide, without prejudice or influence from either party, what the verdict is to be. Trusting that you will insert this in your valuable paper,

I am, Yours truly,
"Newcastler."

To the Editor of "Mining."

ANSWERS TO CORRESPONDENTS.

R.T. (Wigan.)—We will give you the information you require if you will call at our office.

Printed and Published by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

MINING

A Journal devoted to the interests of Mining.

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CONTENTS.

GEOLOGY.

CHAPTER III.

TRACES or remains of vegetable or animal organisms are found in every rock formation, from which a general idea may be gathered of the species and conditions of nature's products, existing at the time in which these flourished. The most permanent form in which these remains have been preserved is where they have collected together in large quantities; isolated traces are not so distinct. As examples of the manner in which these are formed by plants, may be mentioned, the deposits of peat in marshy districts, mangrove formations in the hot swamps of foreign countries, and the seaweed beds. Peat bogs often continue to grow on the decayed remains of the under-growths, and thus a great thickness is formed often to an extent of several square miles, of a depth of anything up to 50 or 60 feet; the lower portions as the decay continues becomes more compact, and acquires a dark brown or black appearance, and as this substance, if dried, will burn, it is not very difficult to see the near connection between the coal measures of the present day and these bog deposits. A curious instance of how objects may be preserved from decay is to be found in lacustrine or lake deposits. As the plants on the sides of a shallow lake are inclined to grow towards the centre, the lake becomes covered with layers of fibrous vegetation, making the whole apparently solid. Animals will often venture upon this and if they are not of a very small species will probably sink through and be drowned. Centuries afterwards this hitherto solid appearance becomes real, and if the peat, as is done in many cases, is cut and dried for fuel, the remains of these animals are discovered in a perfect state of preservation. In Ireland many remains of the *genus* Elk have been found preserved in this way, though the animal itself is never mentioned in any of the histories of that country. In America the mangrove plant grows out into the salt water, forming a growth which fills up the inlets. The sand and mud which is washed up by the sea is retained by the roots of the trees, and thus in time solid ground is found where once the sea penetrated. In Florida there is an extent of swamp of this nature with a breadth of from 5 to 20 miles. A very important deposit is what is known as diatom earth or infusorial earth,

this consists almost wholly of parts of the plants called *Diatoms*, which are found in lakes and in some parts of the ocean, especially in the antartic. These minute organisms are remarkable for the silica which they secrete when dying.

(To be continued).

HAULAGE.

Chapter I.

Rails, etc.

VARIOUS forms of rails have been introduced for the trams or tubs to run upon underground, but the only kinds now used are the T rail (Fig. 1) and the bridge rail usually fastened to transverse sleepers of larch timber about 6in. wide and 3 inches deep, fixed at intervals of a yard by means of either 2 or 2½in. nails or dogs, two nails being used at each intermediate sleeper, one on each side of the rail; and in the case of the joint sleepers four nails are used, two for each rail. For temporary roads however only three nails are used for each rail instead of six.

Steel sleepers have of recent years been introduced to replace timber with more or less success. Fig 1 illustrates one of the best forms of steel sleepers yet invented, and is made by the *Widnes Chair and Sleeper Company*; it possesses many advantages over other kinds as will readily

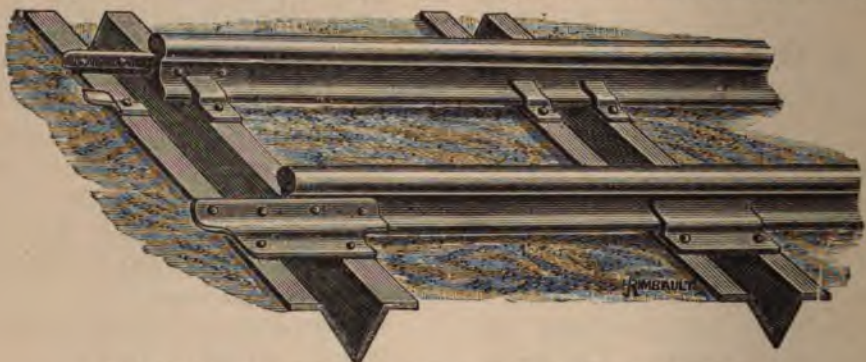


Fig. 1.—View showing arrangement of Steel Sleepers.

(Figs. 2, 3 and 4). The weight of the rails varies from 10lbs. per yard upwards according to the importance of the road and the weight of the trams, and the most common length is two yards, though one yard lengths are used as matching pieces, and four yard lengths are often used for the main roads. In some few cases the joints are fish-plated particularly in highly inclined seams where the trains of tubs run at a high speed and the tubs are heavy. The gauge of the rails varies from 12 to 36 inches, though it is seldom that any gauge under 21 inches is used for coal mining and the most common is about 27 inches. The rails are

been seen; the rails are fixed to the sleepers by a swivel spring clip, which is permanently rivetted to the sleeper; the manner in which this is accomplished is as simple and effective as can possibly be produced. The rail is placed against the back bar-clip of the sleeper, the swivel clip is then hammered round on its rivet until it "mounts" the flange of the rail, one corner only of the clip being bent up to give it a start on the rail. The strain thus put upon the spring-clip in forcing it on the flange is properly adjusted to not only hold the rail tight, but the "spring" on it is sufficient to take up any wear there may be on the

Fig. 2.—View of Old Rail, Inverted to Form a Sleeper.

rail, and thus to form a fastening that cannot wear loose, as the corners of the swivel clip are left square, and fit so closely to the rail that it prevents it from working free. When the rails require removing all that is necessary is to hammer back the swivel clip which is the work of a moment.

This Company have also adopted a novel arrangement for the use of disused bridge rails as pit sleepers. Fig. 2 shows an old rail inverted to form a sleeper, with the jaws of the two fastening clips projecting above, and one running rail in place. Fig 3 shows the sleeper rail with the clip in position and the method of securing the running rail. Fig. 4 shews a perspective view of the clip having two jaws A and B and the tail-piece C, also shewing the upper rail being placed in position. To make the sleepers it is merely necessary to cut say two yard rails into two lengths and punch a hole in the web into which the tail piece of the special clip engages. From Fig. 4 it will be seen that the rail is merely dropped in on its edge, the wedge-shaped jaw B then fastens itself into the hollow of the rail, the out-flange of the rail being wedged under the jaw A; and the rail is thus automatically locked to the sleeper. The best method of laying rails with a view to use old rails in the manner described, is to have ordinary timber sleepers at the joints of the rails, and use the rails as intermediate sleepers; a good road is thus formed and the rail sleeper relieves the timber from all strain.

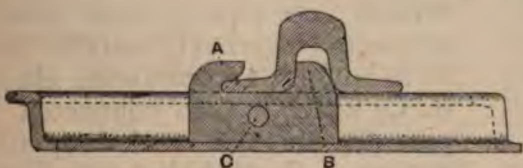


Fig. 3.—Sectional Elevation of Sleeper Rail with Clip shown in position.

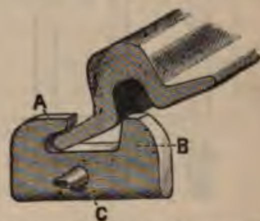


Fig. 4.—View showing Upper Rail being inserted in Clip.

(*To be continued*).

NOTICE TO READERS.

To the Editor of "Mining."

DEAR SIR,

Just a word on two or three very important things that I think should be brought to your notice, and the notice of your readers.

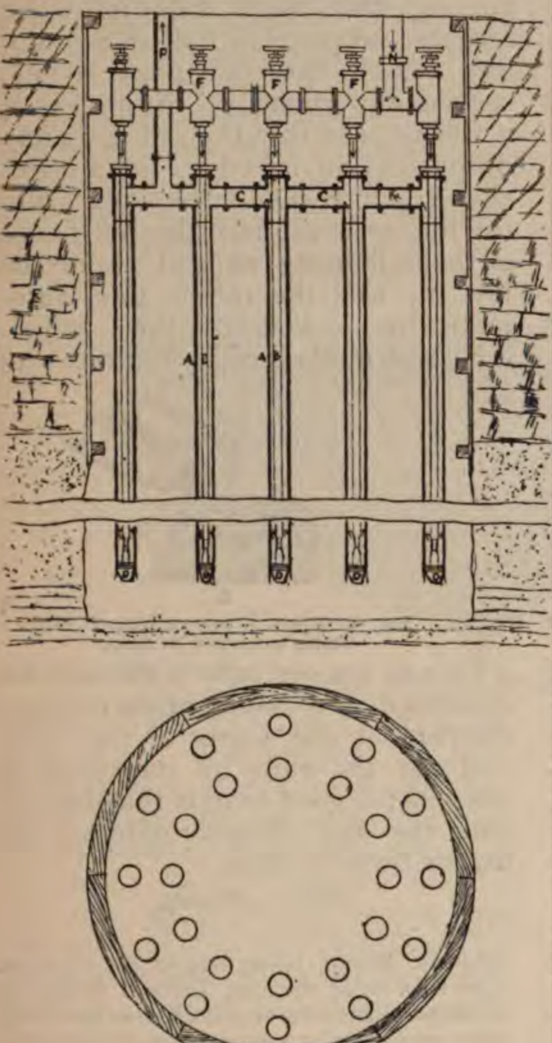
It appears that it is a very common occurrence for communications addressed to the Editor of "Mining," Clarence Printing Works, Wigan, to be delivered at another Office which publishes a paper on miscellaneous subjects, Mining being one of the subjects. This then being the case, I would advise all correspondents to be very careful in addressing their envelopes, or they may meet with disappointment and inconvenience, and, Mr. Editor, I think you should make some change in the title. "Mining," to my mind, is a very vague title for your Journal, and I would suggest that when you commence Volume II. that your Journal be called "The Illustrated Mining Journal."

Yours truly, "CERTIFICATED."

SINKING.

CHAPTER VI.

THE Poetsch's Freezing System is an ingenious method of sinking through quicksand; whereby it is frozen into a solid mass, after which it is cut and sunk through in



Figs. 1 and 2.
Section and Plan of Poetsch's Freezing System.

the ordinary manner. A solution of chloride of calcium is made intensely cold by means of suitable machinery on the surface; and as the freezing point of this mixture is 80° F below that of water, it will be readily understood that it can be made to freeze the water contained in the sand or other material, although it remains a liquid itself. The manner in which the quicksand is frozen is as follows:—Two rows of wrought-iron tubes (A A, Fig. 1) about 8 inches in diameter, are forced through the quicksand at distances apart of about 3 feet, and are arranged so as to form two concentric circles as shown in plan in Fig. 2. The bottom end of the pipes are contracted a little so that when they have reached the solid rock, the bottom of the tubes may be plugged up to prevent the sand from rushing up the tube. The usual method of doing this is by means of leaden plugs (D D) over which is placed several layers of cement; the tops of these tubes are connected together by suitable flanges so as to form a continuous chamber (C C) which is also connected to a pipe (P) which is carried up to the surface. Small holes are left in the top flange of each of the tubes A A for the insertion of smaller tubes B B from 2 to 2½ inches in diameter. These smaller tubes are open at the bottom and are connected at the top so as to form the chamber F F, which is connected to the pipe N and is carried up to the surface in a similar manner to the other. The freezing mixture comes down the pipe N into the chamber F F from whence it is distributed into the narrow tubes B B; it flows through these tubes up the annular space between the two pipes into the chamber C C, and reascends by means of the pipe P, to the refrigerating machine to be used again. This is continued for several days, varying according to the thickness

and depth from the surface of the quicksand.

In the manner above described, a solid cone of quicksand is formed in and around the shaft, of sufficient thickness to resist the external pressure, until a permanent walling is built. Explosives are not allowed during the removal of the frozen quicksand, for fear of shattering the ice-wall.

A brief account of *Triger's* method of sinking with compressed air will be found in the Answers to Questions in this issue.

HEAT.—By Calor.

Chap. VIII.

Solids and Liquids.

All substances can be divided into two classes namely, solids and fluids, though in some cases the substance adopts a medium, and it is very difficult to define to which class it belongs in its ordinary condition. Before we can determine to which class a body belongs we must know definitely what the terms solid and fluid mean. A fluid is a substance which adapts itself to whatever form the vessel may be in which it is contained—not being able to sustain pressure on one side without being supported on the other. For example, if water be placed on a flat surface without sides to contain it, it will flow off; that is to say, it cannot sustain its own weight, and it is always trying to find the lowest level possible. Solids are those bodies which can support pressure (however small) in a vertical direction without being supported laterally. Fluids are again divided into two classes which are termed liquids and gases. The difference between a liquid and a gas is that the liquid, although it alters its shape to local conditions, yet under ordinary circumstances it does not tend to increase in volume, whereas a gas is always endeavouring to occupy more space. Thus a cubic foot of ordinary air may be made to fully occupy a vessel of ten or one hundred times this capacity.

From the foregoing we understand that all bodies are found in one of three states, namely: solid, liquid, and gaseous. Every-day experience tells us that bodies alter their physical condition—that is, change from one of these stages to another according to the temperature. Heat changes solid ice to liquid water, and if this is increased to a still greater temperature it becomes steam, which is a gas.

Fusion.

The change of a body from a solid to a liquid is known as fusion, and this usually occurs at a definite temperature (the pressure remaining constant), and this temperature is known as the melting point of the body in question. With the exception of those bodies such as stone and wood, which decompose when subjected to high temperature, almost all solid substances can be liquified. One of the most notable exceptions however is carbon, which has resisted all efforts up to the present, though it has been reduced to a stage bordering on the liquid, viz.:—flexibility.

The following table of melting points will be found useful:—

Melting Points.

Butter	33°C	Lead	320°C
Sulphur	110°	Silver (pure)	1000°
Tin	230°	Iron	1200°

Ebullition.

The boiling point of a liquid is that temperature at which the tension of its vapour is exactly equal to the

pressure it supports. At the ordinary pressure of the atmosphere water boils at 212°F., but if the pressure be by any means increased the boiling point rises, and *vice-versa*. The variation of the boiling point of water at different stages will be found below.

Pressure in Atmosphere.	Boiling Point.
⅛	123 degrees F.
¼	150 ,,
½	179 ,,
1	212 ,,
2	249 ,,
3	273 ,,
4	291 ,,

Consequently the height above the sea at which the liquid is boiled will affect the boiling point; indeed the height above sea level may be ascertained by this manner, allowing 590 feet of height for every degree F. the boiling point is below 212 degrees. In the case of a steam boiler the boiling point is raised considerably, as the steam is not allowed to escape until it is far above the ordinary pressure of the atmosphere. Similarly, water at an ordinary temperature may be boiled by being placed under the receiver of an air pump. The kind of vessel in which the water is boiled affects it, although the temperature of the steam remains the same. Impurities in the water, such as salt in solution, also change the boiling point. All gases have been liquefied, though it is quite recent that some of the most refractory ones have been changed, an example of which is nitrogen.

Boiling Points of Liquids.

Sulphurous acid	— 10 deg. C.*
Ether	37 ,,
Alcohol	78 ,,
Mercury	300 ,,

* The Minus sign represents degrees below 0.°

Peculiar Expansions of Water.

If heat be applied to water at 0 degrees C. it will be found that instead of following the universal law of expansion it contracts until its temperature rises to four degrees C., after which it expands in the ordinary manner. It will be evident therefore that it arrives at its greatest density when at this temperature, and a little reflection will show us that it is a special act of Providence. If it followed the general rule ice would be heavier than water, and layer after layer would sink in our ponds until the whole would become one solid mass which the heat of summer would not melt. What really takes place is: the temperature of the water at the surface falls until it reaches four degrees C., when being denser than the water below it sinks. This goes on until the whole of the pond is at four degrees C. The surface water will still cool, but as it now expands it remains on the top, and it requires a severe frost to make a layer of ice of much thickness.

(*To be continued.*)

NOTICES.

EXAMINATION QUESTIONS,

With Answers, by

THOS. FLETCHER, First-Class Certificated Manager

The following questions for the examination of Candidates for Certificates of Competency were set in the Lancashire and North Wales District, June, 1892.

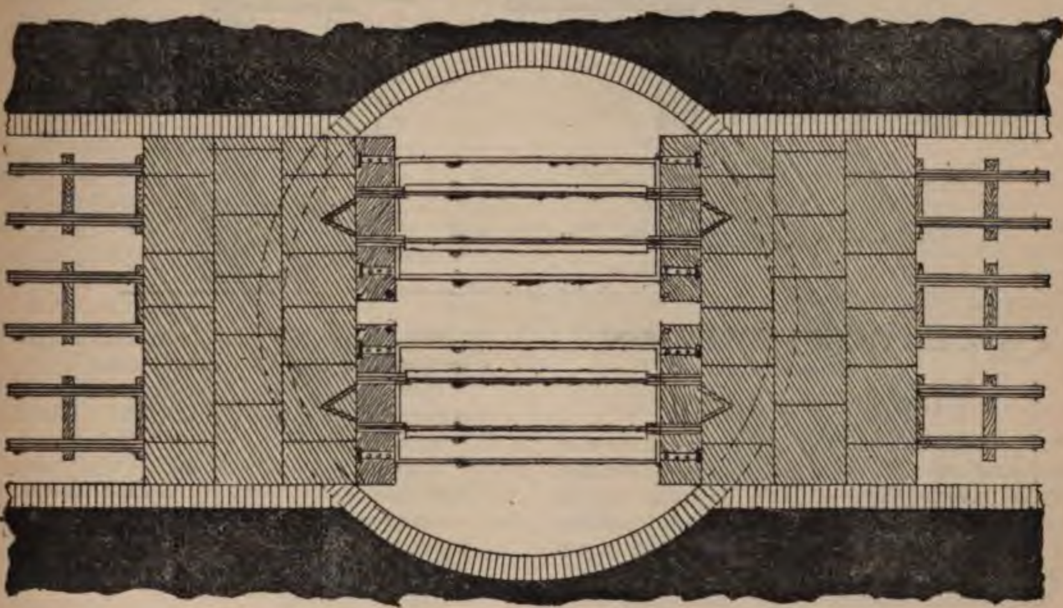
FIRST-CLASS CERTIFICATES OF COMPETENCY.

(Continued from last issue. Commenced in No. 22.)

Shafts.

QUESTION 26.—Describe and sketch the best arrangement for hooking-on coal in a shaft at a mine half-way down to the main shaft, where two cages are used, running on iron weighted conductors.

ANSWER.—I would fix two strong bearers, one on each side of the shaft, about fifteen inches clear from the ends of the cages. From the bearers to the side of the shaft I would fix three-inch planks, and would cover all over with iron landing plates, as shewn in figure. I would fix two wings on each side of the shaft (if there are two mouthings) each of which should be connected to the bearers by two good wrought-iron hinges. The wings may consist of three-inch timber upon which a short length of rails are fixed for the tubs to run from the landing plates to the cage. Each wing should also be provided with two hooks so as to grasp the cage whilst the tubs are being put in. The wings can be pulled back or placed in position with the cages by means of a chain fastened to one corner.



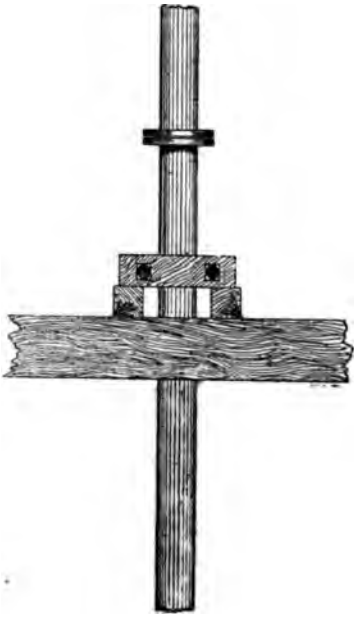
QUESTION 27.—What are the special difficulties to be arranged for in the sinking of a shaft in entirely new ground? State how you would proceed at the commencement.

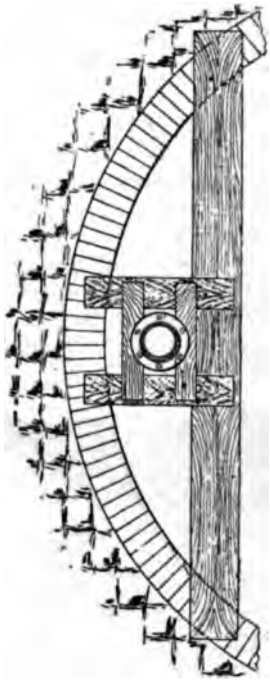
ANSWER.—The special difficulties to be arranged for are water and loose ground, such as sand, gravel, etc. Before I commenced sinking I would put down at least one bore-hole to the solid, and if there was quicksand, the diameter of the excavation at the commencement should be much larger than the finished size of the shaft (proportionate to the depth of loose ground), so as to allow of pile driving previous to putting in the walling.

QUESTION 28.—Describe, by a sketch, how you would secure a range of twelve-inch cast-iron water pipes, in a shaft fifteen feet diameter, and three hundred yards deep. Give sizes of timber and other material used.

ANSWER.—The sketch shews the method I would adopt in fixing a range of twelve-inch water pipes in a shaft. I would have the main bearers or "horse-trees" fifteeen inches deep and eight inches wide, and fixed at intervals of about nine yards, down the whole depth of the shaft. The cross-pieces from the bearer to the brick-work of the shaft should be nine inches deep by six inches

wide, and the clamp pieces may consist of timber as shewn in sketch, or short lengths of railway metal curved to the sweep of the pipes. I prefer oak timber for this description of work, but metal girders may be used with advantage when space is limited in the shaft, and to give clearance space when wire rope conductors are used.





PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules:—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by November 11th, 1893.

Question 1. (E.)—Explain, with sketch, angle bobs for pump spears changing from the vertical.

Question 2. (E.)—How do you account for the disjointing of our widely-distributed Coal Measures strata, and for the absence of it now?

Question 3. (E.)—Explain, with sketch, the longwall method of working coal.

Question 4. (A.)—Describe, with sketch, the construction of the *Waddle* fan. Discuss its effectiveness.

Question 5. (A.)—Describe the principal methods used in working deposits of rock salt.

Question 6. (A.)—What are the disadvantages (if any) of using cast-iron tubing in furnace shafts, and what would you do to overcome them?

Question 7. (H.)—In preparing a self-acting incline, how would you arrange the gradients at the top and bottom of the plane?

Question 8. (H.)—Describe the method of sinking a pit through water-bearing strata, having very soft ground to commence with. Give dimensions of the materials you would use for a sixteen-feet pit.

Question 9. (M.)—Give a sketch of a full-sized district of bord and pillar workings, showing how the air is taken round the face. All stoppings, crossings, regulators, sheets and doors to be shown.

Question 10. (M.)—What are the regulations of the Mines Act as to hours of boys above and below ground, fixing of machinery, precautions in approaching old workings, refuge holes? (State in own words.)

ANSWERS TO QUESTIONS

In No. 23.

Question 1. (E.)—Describe fully the processes by which coal is taken from the working face to the shaft.

Answer.—The coal is first loaded into the corves, tubs, or trams by the collier or filler at the face. Then (1) it is brought to a little flat or pass-bye either by hand-putters, hurriers, or pony-putters according to the inclination; then (2) these full tubs are brought out in sets of four six, or eight, to a large pass-bye or landing, by horses. Next they are coupled together into large sets or trains varying from thirty to seventy, that is in case the system of main-and-tail rope haulage is used. When these sets or trains are brought out to the pit bottom this system needs only one single way, but two ropes are used—the main rope for hauling the full tubs out-bye, and the tail rope for hauling the empty tubs in-bye. The speed is from six to ten miles an hour. This method of transit is very efficient where the roof is extra bad. The second mode of transit by engine power is the endless rope method which requires two lines of rails—one for the empty tubs, and one for the full tubs. The tubs are fastened on the rope at intervals of from ten to twenty yards apart, one or more at a time. The endless rope is preferred where there is a good strong roof, consequently a wide road can be made and maintained very cheaply. The speed is from two to four miles per hour, when the coals are delivered regularly at the pit bottom, and the supply o empty tubs are the same at the coal face. Where there is sufficient inclination to cause the descending full tubs to pull up the empty tubs, jigs or self-acting inclines are favourably adopted, being regulated by a brake. The most favourable inclination in this case is about one in thirty for the transit of coal.

JOS. DAVIES,
New Co-op. Houses,
Mapplewell, nr. Barnsley.

Question 2. (E.)—State the principle of the different classes of pumps used for mine drainage.

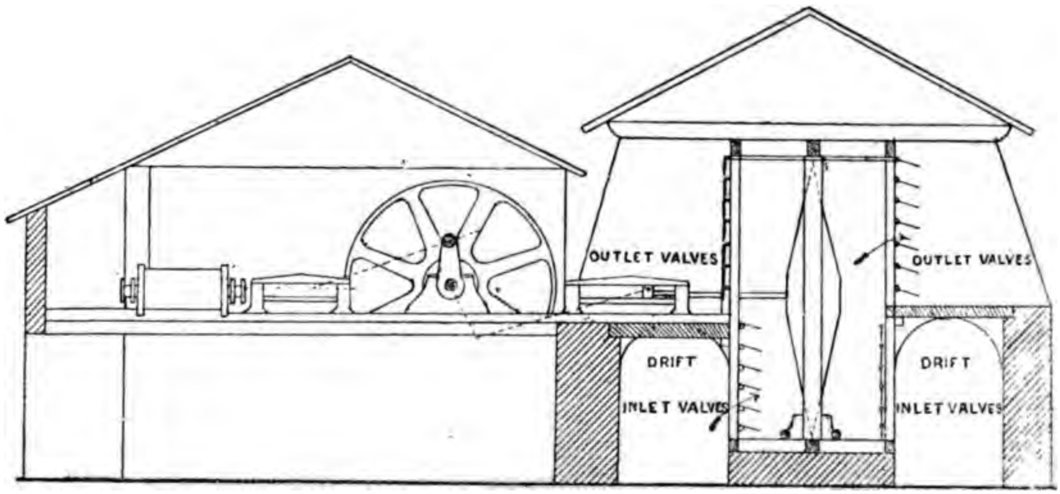
(No satisfactory answer received.—Ed.)

Question 3. (E.)—How would you first proceed in searching for coal?

Answer.—First by making a general survey of the district, observing the nature of the ground through which the rivers and brooks have scooped their way, and examining quarries or the section showed by any raised cliffs in the neighbourhood. Ploughed fields, or the beds of rivers, etc., may sometimes furnish indications of an out-crop. A spring of water depositing ochreous oxide of iron is a good indication of the existence of coal, but it is not by any means infallible as this mineral occurs in other classes of rocks. The presence of shales are also favourable, but these may likewise belong to the Silurian or other formations, though a very good idea may be formed by the examination of the fossils which usually occur in these shales.

JOSEPH FOSTER,
34, Lily Lane,
Bamfurlong, nr. Wigan

Question 4. (A.)—Describe with sketch the construction of some air pump designed for ventilation.



Answer.—*Nixon's* Air Pump consists of two large rectangular chambers in which pistons travel backwards and forwards on rollers. In one of these machines in South Wales the pistons are thirty feet wide and twenty-one feet high, with a six-feet stroke. Two sets of flap valves are fitted at each end of the chambers, one set for in-let from the mine, and the other for out-let into the atmosphere. Each set of valves contains ninety-eight, size about twelve inches by fifteen inches. The pistons are attached to the engine shaft by cranks placed at right angles to each other. This machine entails great expense in keeping the valves in repair to prevent leakage, and it is not suitable for producing a large quantity of air, as it cannot be worked at a high speed with economy.

JOHN WORRALL,
137, Wigan Road,
Westhoughton, Lanc.

Question 5. (A.)—Describe the system and object of sinking pits under a great pressure of air.

Answer.—The system of sinking pits under a great pressure of air is known as *Triger's*, the object being to sink pits through wet ground such as gravel and soft sand, dam back the loose material, and keep the shaft clear of water without the aid of pumps, so that the workmen will be enabled to work with comparative freedom. A tube built of hollow cast-iron cylinders bolted together, with inside flanges, is allowed to sink into the soft ground. Inside this tube two platforms connected by a cylindrical case are made to slide up and down, both platforms being provided with a door and safety valve, so that two air-tight chambers are formed. A pipe is fixed for the admission of air at high pressure from the engine at the surface, to force the water up another pipe from the lower chamber to the surface against the pressure of the atmosphere. The upper portion of the tube is loaded with tons of pig metal to overcome the lifting power of the compressed air, and force the construction into the ground as the material is removed. The tube being fixed and the air engine set to work, two men are lowered to the second platform, the door above closed, and the air above and below this platform is equalised by allowing it to slowly pass through the safety valve. The sinker then descends into the bottom of the tube, fills the material into buckets which are hoisted into the chamber above until the platform is filled. The door of the second platform is now closed, the pressure between the middle chamber and the external chamber equalised, and the buckets passed to the upper platform and emptied. Great care must be exercised in the management of the valves by the workmen, or the results may be fatal. It has been found that this system is not suitable for more than eighty or ninety feet deep, owing to the conditions under which the men have to work.

SAMUEL THORPE,
Chevet View,
Ryhill, Wakefield.

Question 6. (A.)—How many cubic feet of water is there in a six-sided shaft 100 yards deep? The sides are each two feet long, and the angles contained by the side are equal.

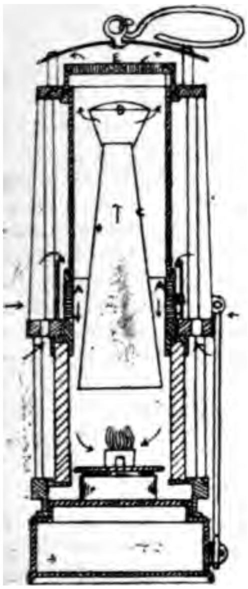
Answer.—To obtain the area of a regular six-sided polygon we multiply the square of one side by 2·5980762 (a constant number which is found by Trigonometry), and to obtain the cubic feet of water in the shaft mentioned we then multiply the product of the above by the depth in feet, viz.:—300. Thus $2 \times 2 \times 2{\cdot}5980762 \times 3 \times 100 =$ $\underline{3117{\cdot}69144}$ cubic feet.—Answer.

SAMUEL HOPE,
Mosley Common,
Boothstown,
near Manchester.

Several Competitors were correct in this answer so we had to resort to lottery to ascertain to whom to award the prize.—Ed.

Question 7. (H.)—Describe with sketch the construction of a gauzeless safety lamp.

Answer.—The illustration shews the *McKinless* Lamp. The principal feature of this lamp is that gauze is entirely discarded.



The atmosphere (for feeding the flame) enters above the glass and middle ring of the lamp, throngh a number of very small holes drilled or bored in a belt or band; the diameter of these holes is about $\frac{1}{28}$ of an inch, and their length about $\frac{1}{6}$ of an inch. The air passes thence between this belt or band, and an inner shield or chimney to the flame. On the outside of the in-let holes (and inside the tin shield or bonnet) there is attached to the middle ring of the lamp another shield or band which protects the inlet holes from a strong current.

REFERENCES:—
A—Bel or Band, with small in-let holes.
B—Shield or Band, to protect in-let holes from strong currents.
C—Chimney.
D—Cap or Belt, for collecting soot, &c.
E—Horizontal Plate, with small out-let holes.

The products of combustion pass through a chimney or tube (similar to the Mueseler chimney); the top of this chimney is reduced to a diameter only sufficient to pass the ordinary results of combustion. Attached to the top of the chimney is a cap or belt which collects soot or other unconsumed particles. On the top of the main cylinder or tube of the lamp is a horizontal plate, in which also are a number of small holes of a much greater length than their diameter, and through these the burnt gas and products of combustion escape. The weight of the lamp is about five pounds, and has been carefully tested in a fiery mixture of high velocity.

MATTHEW CHAPMAN,
17, Kiveton Park,
near Sheffield.

Question 8. (H.)—What are the qualities required in a steam coal for navigation purposes? Where are such coals produced in the United Kingdom, and how are they prepared for sale?

Answer.—Qualities required:—(1) Must be as free from impurities as it is possible to obtain, such as shales, iron pyrites, and such materials as tend to produce a large percentage of ash. (2) The coal should be smokeless or nearly so. This is essential, so that the atmosphere be not over-clouded with smoke in times of war, and it is very necessary that as little indication be given of our presence to the enemy as possible. (3) Coal for this purpose should have great heating power, so that the steam may be raised quickly to a great pressure, in cases of emergency. (4) It should be hard, so that it will not be broken in transit from the coal face until shipment. (5) It should burn freely, and be non-caking. Coal having the above qualities is found chiefly in South Wales and Northumberland. The coal of South Wales is the best and was recommended by the Lords of the Admiralty for use in the Navy, the coal preferred being the four-feet and nine-feet seams which are known as Merthyr Upper four-feet, and Merthyr Tydvil nine-feet.

The coal is prepared for sale by screening and picking:—(1) SCREENING.—The coal is tipped on to a screen, and the coal below a certain size falls through the bars of the screen into trucks, and the large coal falls over the screens into other trucks. (2) PICKING.—The coal is screened on to travelling belts, which are in some cases twenty to thirty yards long. While the coal is moving along the belts all stones, pyrites, shales, and impurities are picked out by attendants. In some cases the coal is also sized, such as nuts, peas, small, etc., each size falling into separate trucks.

THOMAS BEST,
Railway Street,
Tow Law, Co. Durham.

Question 9. (M.)—A very high fall has occurred in a main haulage road. How would you remove the debris and re-timber the place?

Answer.—When the necesssary directions have been given for having the debris cleared away and the roof properly secured, and until this shall be done (if the roof is soft, tender, and of a loose sandy nature which chokes and impedes the ventilation) no miner or any workman should be allowed to proceed near or be under the broken roof, unless such be thoroughly experienced, have a large amount of practical knowledge, and are employed in remedying the same. There should be no men allowed to work at the coal faces until a road is made over or alongside of the fall. The question says "a very high fall." We take it for granted that the roof has broken and fallen several yards in thickness, closing the main road for scores of yards in length. Once or twice we have had such falls to contend with, which had fallen from eight to

twelve yards high and nearly two hundred yards long, in soft ground. To open or remove the same we commenced by setting a pair of couples or square frames of strong cross-bars and legs notched at the ends. Then we decided to drive strong pointed piles, six feet long, over the bar into the fallen debris with the leading or innermost points shooting upwards, so as to give room for the next pair of couples with its cross-bar to be set under or beneath these piles. Before commencing to remove the fallen material the roof should be secured, and all the bars lined with either strong suitable timber or steel girders supported with props, and caps or recesses cut on each side of the road. While driving the piles and removing the dirt, I would set a temporary middle prop and a light bar under the leading points of them to keep them up until they were driven far enough. Thus we continued, pair after pair, until the whole length of the broken ground was opened out and made secure again. Sometimes it was necessary to use the screw-jack to force the piles up sufficiently to allow room for the next bar.

SAMUEL DAVIES,
New Co-Op. Houses,
Mapplewell, nr. Barnsley.

Question 10. (M.)—What would you do to prevent the formation of ice in a shaft?

Answer.—To prevent the formation of ice in a shaft (downcast) I would first endeavour to dam back by puddling with clay, or to collect into the water rings all feeders of top water. Then I would adopt the method employed at many large collieries throughout the kingdom, viz.:—To make one or two fires on suitable erections at the surface of the downcast shaft, to warm the air in its passage down. The fires should be placed a few feet below the ground level, and should be kept at a temperature sufficient to raise the air several degrees above the freezing point of water. Coke should be burned in these fires, if possible, as the smoke, etc., from coal is troublesome to the workmen on the pit staging.

The steam jet is another method employed to overcome this difficulty. It consists of a length of pipes extending from the boiler to the shaft, the end of which is fitted with a stop-cock so that a quantity of steam may be allowed to escape into the shaft, and thereby raise the temperature of the air.

JOHN COOK,
28, Smithy Green,
Smithies, nr. Barnsley.

CORRESPONDENCE.

26, Havelock Street,
Felling, R.S.O.,
Co. Durham.

Dear Sir,

Would you forward me Nos. 1 to 17 inclusive, of "*Mining*," for which I enclose one shilling and fivepence (1/5) in stamps, and you will much oblige.

I shall endeavour to increase the circulation of your very valuable and at the same time cheap Paper, by recommending it to my friends, as I am sure it deserves a very large circulation, which undoubtedly would be obtained, if its merits were only made known.

Yours very sincerely,
ALEX ALDERSON.

To the Editor of "MINING."

As you are wishing to increase the circulation of your valuable Paper, which, when once read through, speaks for itself as a good learning, simple and interesting Mining Paper, I took it into my hands to speak to a few mining students attending the same class as myself about your paper. One student said he would order it right away, and several of the others seemed pleased to hear of such a cheap Mining Paper.

AN INTERESTED STUDENT.

IMPORTANT NOTICE.

Our next Number (26) will conclude VOL. I. of this Journal.

The Volume, handsomely bound, gilt lettered, with an elaborate index, and illustrated title page, can be had at this Office, at the following prices:—

FULL CLOTH 4s. 0d. post free.
HALF LEATHER 4s. 6d. ,,

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The index and title page to this volume will be presented to every reader with No. 1, of Volume II.

This volume will be the cheapest book on Mining attainable, and all readers should endeavour to possess one for reference.

Printed and Published by STROWGER AND SON, Clarence Yard, Wallgate, Wigan.

MINING

A Journal devoted to the interests of Mining.

No. 26. Vol. I. NOVEMBER 16, 1893. FORTNIGHTLY ONE PENNY

CONTENTS.

SINKING.

CHAPTER VII.

KIND-CHAUDRON.

THE Kind-Chaudron system of sinking, or more strictly speaking of boring shafts, is the best and most economical that can be adopted in strata that gives off large quantities of water, which would entail large and costly pumping appliances to keep the shaft clear for the insertion of walling or tubbing. The shaft is bored in two, and in case of very large shafts in three operations, the first of which bores a shaft of about 4 feet 6 inches in diameter, and the second (and third, if required) process enlarges this to the full size. The smaller or inner shaft is kept about 20 yards in advance of the larger shaft. The advantages to be gained by this series of operations are as follows:—The lower cavity affords storage for the cuttings of the larger trepan, and keeps it concentric. The smaller trepan by which the first shaft is bored is forged in one piece of solid iron for hard rock. At the base of this piece fourteen holes are made in position shown in plan on lower part of Fig. 1. Into these holes or recesses chisels are fastened, each of which weighs 72lbs. the total weight of the trepan being 8 tons. The chisels are secured by a pin which can easily be removed when they require sharpening or renewing. About 4 feet above the chisels a strong iron cross-beam is fixed, fitted with tooth-shaped chisels at its extremity. These serve to keep the trepan in its proper position, and the chisels cut off all iregularities and slightly enlarge the shaft. A few yards above this two cross-bars are fixed at right angles to each other as a further guide. This cutter makes about ten strokes per minute, and after a few hours work it is taken up to allow the sludger, which is 6 feet long and is provided with two valves in the bottom, being lowered to remove the debris. The cutter bores from 4 to 8 feet per day according to the nature of the strata. The large trepan (Fig. 2) which is next brought into operation differs slightly from the smaller one. The cutting tools are fastened to a heavy bar of iron in a similar manner to those in the smaller trepan; but chisels are not requisite in the centre of the bar. Instead, however, of having the chisels the same size they are made longer towards the centre, so that the bottom of the larger shaft

Fig. 1.

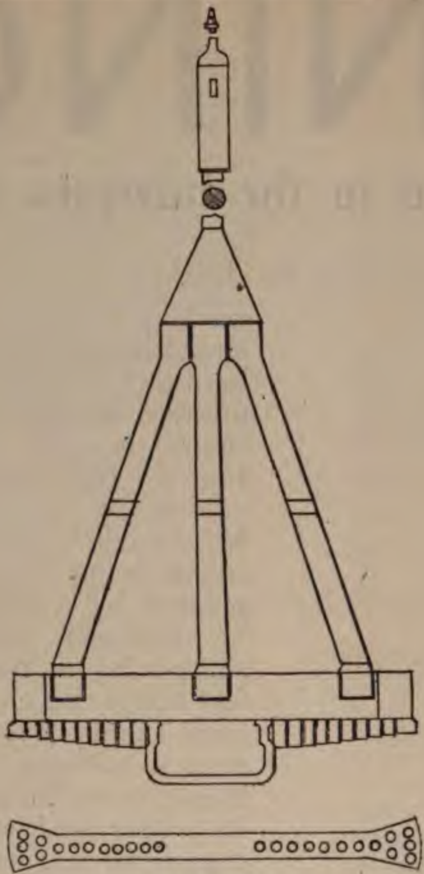


Fig. 2.

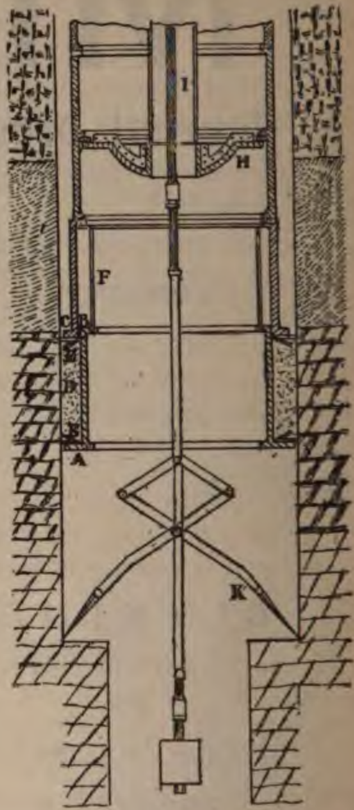


Fig. 3.

will incline slightly towards the centre and the *debris* will fall into the smaller shaft, at the bottom of which is placed a sheet-iron bucket for the reception of the material. In the centre of the bar of the large trepan an arrangement of curved iron is fixed which fits into the smaller shaft and keeps the tool concentric. The tool has a total weight of 16 tons, and the chisels are the same weight as those in the small trepan. The rate of progress of the large trepan varies from 1 to 3 feet per day. The guides are made so that they form a cross which fixes itself in a certain position, and the cutter-rod slides freely through a central opening. The rods which actuate both trepans are made of pine about 8 inches square. Each rod is about 20 yards long and they are connected one to the other by suitable screws. The end of the top rod is connected to one end of a lever by a chain, the other end of the lever being fastened to the piston rod of a steam engine, and a steam capstan is used for raising and lowering the rods. Four or five men are sufficient to conduct the whole working of this machine. They occupy a position on two flap-doors fixed about 6 yards from the surface. The boring rods work through a hole in the centre. After the shaft has been bored the tubbing of the shaft is commenced, and this operation is also conducted without the necessity of the men going down the shaft. The tubbing consists of cylinders of iron about four feet deep, and the diameter of the shaft. These are provided with

flanges turned inward, by means of which they are bolted together and lowered down the shaft. A special arrangement called the moss base is fitted at the bottom in order that a perfectly water-tight bed may be procured. The bottom flange (A, Fig. 3) is turned outward, and the top one inward; immediately above this another cylinder is placed in a similar manner, but a little larger in diameter than the first one. The reason for so doing is in order that this larger cylinder will slide down outside the lesser one. The space between the bottom flange (C) of the second cylinder, and the bottom one (A) of the first cylinder, is tightly packed with moss (D) before they are lowered, and the moss is held in position by a net placed round it. Small sheet iron springs (E E) are fixed at the top and bottom of the moss box to assist in forcing the moss against the sides of the shaft. The second cylinder is connected to those above in the ordinary way, but the bottom cylinder is simply supported by light rods (F) which holds it in the position shown when the weight of the cylinder is upon it, but when it becomes supported on the bedding at the bottom of the shaft, the rods move downward through the holes in the flange (B). The second cylinder slides down the bottom cylinder, and the moss is pressed tightly against the side of the strata, and the whole acts like a stufting box and gland. Of course it is necessary to sink several feet into impervious strata, in order to make a water-tight joint with the moss. To render the lowering of the cylinder easier, a false bottom (H) is bolted to one of the flanges at the bottom of the tubbing, and this causes it to float on the water in the shaft. This greatly alleviates the tension on the suspension rods. A central tube (I) is fitted to the false bottom, and passes up the shaft, through this the water can be regulated to allow the tubbing to gradually descend. A large pair of pincers (K) is lowered with the tubbing, this is done by a rod passing up the central tube, and by working this up and down the pincers are made to remove any material that may tend to affect the making of a good bed for the moss-box. After the tubbing has been fixed in place the space behind is filled with hydraulic cement, which is allowed to set before the water is withdrawn from the shaft. After this has been done the men remove the false bottom and descend to the bottom, when, as an extra precaution, a wedging-crib is put in immediately, a few feet below the moss box, and the tubbing is built up to it. When this is completed the sinking is done in the ordinary manner.

GLOSSARY OF MINING TERMS

(NORTHUMBERLAND)

COMMUNICATED.—*Commenced in No. 24.*

Cabin—A small room or office in a mine for the use of the overmen, rolley-way-man, &c.

Cage—A carriage for raising and lowering coal, persons, &c., in a shaft.

Canvas-door—A screen of tarred canvas hung across a haulage road.

Carbonic-oxide—A gas composed of equal parts of carbon and oxygen, which is very poisonous.

Cattering-arse—A cone-shaped stone in the roof, resting on the coal.

Cavel—The working place or places which have been gained by lottery by a set of men. Four men form a set.

Caveling-day—A day for the lottery of the cavels every three months.

Chairs—Shoes, into which fit the ends of the rails of a haulage road.

Check—A note from the under-manager or overman, of the sum of money that is to be drawn at the pay office, on the pay day, by a set of men, or man.

Check-rail—A rail laid against the inside rail of a curve on the inside.

Checkweighman—The man engaged by ballot by the hewers to look after the weighing of their coals.

Chisels—Bits; cutting tools used in boring.

Chock—A block of hard wood arranged to knock off or fix across the haulage road to prevent the tubs running away.

Chock—A building of blocks of hard wood to support the roof.

Clack—A valve or valves in a pump set to prevent the water falling back in the set.

Clack-door—The entrace to the clack.

Coupling-chain—The chain on the end of a tub for connecting it to another.

Cow—A bar of iron hanging loosely from the last tub of a set when going to the rise, to stop them running back. Also called "devil."

Crackel—The miner's stool or seat.

Cradle—A movable scaffold used in a shaft for shaft work.

Cradle-crab—The machine for raising and lowering the cradle.

Creep—A rising of the floor in a mine.

Cribs—Wood rings in a sinking shaft to support the backing dales.

Cross-cut—A place driven cross-cut to the cleat of the coal.

Dam—A building to keep back water.

Deputy—A person having charge of part of a mine.

Double-decked Cage—See cage. Having two compartments.

Double-way—Two pairs of rails on a haulage road.

Down-cast—The inlet shaft for air into a mine.

Down-throw—A fault which throws the seam below its preceding course.

Drawing—The work of taking out the timber which was set to support the roof.

Dregs—Pieces of wood or iron put into the tub wheels to hinder them running round.

Drill—A sort of chisel or auger for boring a hole for blasting purposes or wedging.

Drilling—The art of boring a hole for an explosive or wedge.

Driver—A boy who drives a horse or pony in a mine.

Dumb-drift—A drift to carry off the return foul air clear of the ventilating furnace fire.

Dyke—A fault of whinstone, &c., which passes through the coal seams.

Engine-plane—A common name for a haulage road when it is done by an engine.

Engine-shaft—The shaft for raising the water out of the mine.

Face—The coal at the working-place.

Face-pillar—The pillar or wall of a pack which runs on a line with the face in a gateway.

Fan—The machine for ventilating a mine.

Fault—A breaking of the seam, throwing it out of its ordinary course.

Fire-damp—An explosive gas composed of hydrogen, four parts; and carbon, two parts.

Fire-holes—That part of the boiler shade where the boiler fires are fed with coal.

Fire-man—The man in charge of the boilers and fires.

Fish-plates—Iron plates connecting the ends of iron rails, one on each side.

Flat—The place for landing the tubs after leaving the face.

(*To be continued.*)

The shaded portion represents shaft pillar
The direction of current is shown by arrows
U Upcast (fan pit)
D Downcast (winding pit)

D D Doors
R Regulator Doors
| | Stoppings
| | Cloth Sheets

The above Plan is a copy of that given at the Manchester Examination, December, 1892.

EXAMINATION QUESTIONS,

With Answers, by

THOS. FLETCHER, First-Class Certificated Manager

The following questions for the examination of Candidates for Certificates of Competency were set in the Manchester District, 1890.

FIRST-CLASS CERTIFICATES OF COMPETENCY.

QUESTION 1.—Pay bill for three colliers and two boys for six days' work :—

55 tons of coal, at 2s. 3½d. per ton.
5½ yards, at 3s. 11d. per yard.
3¾ days, at 4s. 11d. per day.
Deductions : Sharpening, 1d. per man per day.
Oil and lamp, 1d. per man and boy per day.
Club, 3d. per man and 1½d. per boy per week.

Reckoning three boys equal to two men, what amount will each man and each boy receive for his share? (marks 3).

ANSWER.—

	s.	d.
55 tons at 2s. 3½d. per ton =	126	0½
5½ yds. at 3s. 11d. per yd. =	21	6½
3¾ days at 4s. 11d. per day =	18	5¼
Total =	166	0¼

	s.	d.
Sharpening, 3 men at 1d. each for 6 days	1	6
Oil and lamp, 5 men and boys 1d. each for six days	2	6
Club, 3 men at 3d. each, 2 boys at ½d. each..............................	1	10
Deductions......	5	0

166s. 0¼d. — 5s. 0d. = 161 0¼d. = £8 1s. 0¼d.

Two men equal three boys, therefore three men equal four-and-a-half boys, therefore three men and two boys equal six-and-a-half boys. £8 1s. 0¼d. equals the wages three men and two boys, or six-and-a-half boys will receive, therefore one boy's wages equal £8 1s. 0¼d divided by 6½ equals £1 4s. 9 3/13

and as a man's wages are equal to one-and-a-half boys, his wages will be half as great again as a boys. £1 4s. $9\frac{3}{13}$ divided by two equals 12s. $4\frac{8}{13}$d. plus £1 4s. $9\frac{3}{13}$ equals £1 17s. $1\frac{11}{13}$d.

QUESTION 2.—The circumference of a pit is to be 39·27 feet on inside face of brick-work. Allowing for a brick lining of 9 inch thick, with 3 inches of backing, how many cubic yards of ground will be got out per lineal yard sunk? (3)

ANSWER.—The circumference divided by 3·1416 equals diameter, therefore 39·27 divided by 3·1416 equals 12·5 feet inside diameter. The diameter of excavation will be $12·5 + (\frac{3}{4} + \frac{1}{4})\,2 = 12·5 + 2 = 14·5$ feet. Diameter squared × ·7854 = area of excavation. $14·5^2 = 210·25 \times ·7854 = 165·13035$ square feet ÷ 9 = 18·3478 square yards × 1 yard deep = 18·3478 cubic yards.

QUESTION 3.—A square cistern is 4 feet deep, and contains 961 cubic feet, what is the length of each side? (3).

ANSWER.—Length multiplied by breadth multiplied by depth equals capacity, therefore 961 ÷ 4 = 240·25 equals square of sides. The square root of this equals:—

1	240.25	15·5
1	1	
25	140	
5	125	
305	1525	
	1525	
	...	

15 feet 6 inches, length of side.

QUESTION 4.—What horse-power would be required to haul 20 full tubs, each weighing $10\frac{1}{4}$ cwt., up an incline with a rise rise of 1 in $3\frac{1}{2}$, at a speed of 200 yards per minute, the friction of the tubs being $\frac{1}{50}$ of the weight, and neglecting the weight and friction of the rope?

ANSWER.—$10\frac{1}{4}$ cwt. × 20 = 205 cwt. × 112 = 22960 lbs. weight.

200 × 3 = 600 ÷ $3\frac{1}{2}$ = 171·43 vertical height in feet.

22960 ÷ 50 = 459·2 × 600 = 275520 resistance of friction.

22960 × 171·43 =	3936000
Add for friction	275520
	4211520

4211520 ÷ 33000 = 127·62 horse power.

QUESTION 5.—What pressure of steam, and what of steam boiler, do you prefer? State your reasons, and say what fittings you consider essential to ensure safe working? (6).

ANSWER.—I prefer a Lancashire boiler for generating steam, but to what pressure would depend on existing circumstances. But for new plant I would have boilers which could be worked up to one hundred and fifty pounds pressure. The fittings that are essential to safe working are a reliable pressure gauge, safety valve, water gauge, fusible plugs, and a low water alarm valve.

QUESTION 6.—In a shaft 400 yards deep there is a feeder of water of 50 gallons per minute, at a depth of 120 yards from the surface, and another, of 200 gallons per minute at the bottom. Describe fully, with dimensions, the pumping arrangements you would employ? (6).

ANSWER.—It is well to calculate for double the quantity of water as pumps are very apt to get out of order, and it is necessary to have more than sufficient power. 200 gallons × 2 = 400.; and 10% for slip = 440 gallons. Take speed of pump as 200 feet per minute, 440 ÷ 200 = 2·2 gallons per foot of stroke.

To find diameter rule is:—

$$d^2 \times ·034 = \text{No. of gallons},$$

therefore diameter $= \sqrt{\frac{2·2}{·034}} = \sqrt{64·7}$ = 8 inches nearly. Say two single acting rams four-feet stroke and 50 strokes per minute. With a pump of these dimensions the water from the bottom could be lifted to the top feeder. A second pump must now be employed to lift the total 250 gallons to the surface. Its dimensions are found as follows:—250 × 2 = 500, add 10% = 550 gallons. Say it works at same speed as the first, 550 ÷ 200 = 2·75 gallons per foot of stroke. $\sqrt{\frac{2·75}{·034}} = \sqrt{80·8}$ = 9-ins. nearly.

To find size of first steam cylinder:—

280 yards = 840 feet.
1 gallon = 10 pounds.
840 × 400 × 10 = 3360000 ft. lbs.

Engine gives 50 % of useful work.
Hence 3360000 × 2 = 6720000.

Piston travel = 200 feet and say effective pressure of steam=40lbs. and two cylinders.

The Diameter $= \sqrt{\frac{6720000}{200 \times 2 \times 40 \times ·7854}} = \sqrt{535} = 23 +$, say 24 inches diameter cylinders.

To find size of cylinder for top lift :—

120 yards = 360 feet.

$360 \times 500 \times 10 = 1600000$ foot pounds.

$$\text{Dia.} = \sqrt{\frac{1600000}{200 \times 2 \times 40 \times \cdot 7854}} = \sqrt{128} = 11\times, \text{ say } \underline{\text{12-inch cylinder.}}$$

It would not be practical to have the stroke of this cyl. 4ft. as it would be out of proportion. But if a cyl. with a 2-ft. stroke is used the No. of strokes per min. will have to be double, or if the cyls. are made larger the piston speed can be reduced. (*To be continued.*)

PRIZE COMPETITION.

QUESTION PRIZES.

A prize of one shilling will be given for the best original answer to each of the questions given below. The editor's decision to be final. A competitor may answer any number of questions in one stage; but he must confine himself to that particular stage.

P.S.—The questions for Managers and Honours to be classed as one stage. Competitors must adhere to the following rules :—

1st—All envelopes must be marked "COMPETITION."

2nd—To be written on separate sheets of paper with name attached, and on one side of the paper only.

3rd—Correct name and postal address must be sent.

4th—They must reach us by November 25th, 1893.

Question 1. (E.)—Explain, with sketch, the mode of action of a common lift pump.

Question 2. (E.)—Of what use are fossils, and which would lead you to consider that coal would exist in the locality in which they were found?

Question 3. (E.)—Describe, with sketch, the Marsaut Safety Lamp.

Question 4. (A.)—Describe the lime cartridge method of breaking down coal.

Question 5. (A.)—Describe the various arrangements adopted for guiding cages in a shaft, when drawing at a high speed.

Question 6. (A.)—Describe the Lanarkshire Coalfield.

Question 7. (H.)—What precautions should be adopted in working a colliery liable to sudden outbursts of gas?

Question 8. (H.)—Describe, with sketch, the *Mather and Platt* method of deep boring.

Question 9. (M.)—What are dry and wet air compressors? Which kind is preferable, an why?

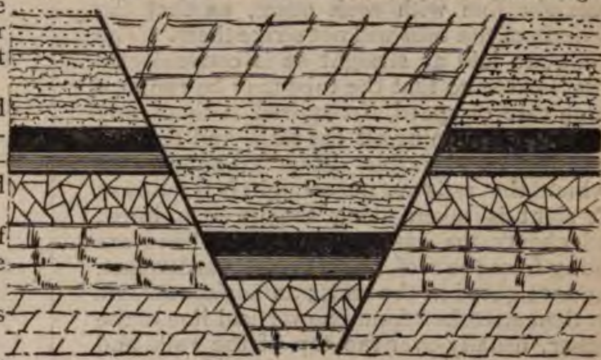
Question 10. (M.)—What considerations would guide you in drilling holes for shots in a sinking pit bottom, and what are the arrangements you would make for firing?

ANSWERS TO QUESTIONS

In No. 24.

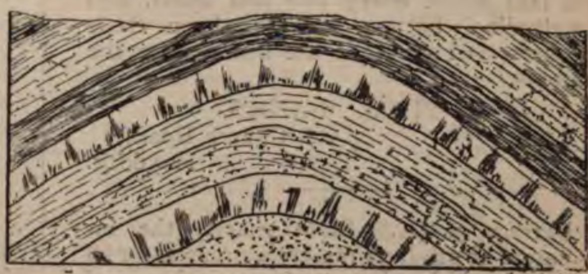
Question 1. (E.)—Explain with diagrams a trough fault, inverted strata, and inlier.

Answer.—A trough fault consists of a pair of faults hading or dipping towards each other, the intervening strata being thrown down. Inverted strata occurs where the strata has been subjected to great lateral or side pressure, with the result that the hitherto horizontal strata has become contorted and twisted into folds, so that what originally was on the top of any particular strata occupies the position below. Inliers are isolated patches or masses of rock which rise up from below other foundations of later age.



Trough Fault

Inverted Strata



Inlier

W. H. HARDY,
37, Princes Street,
Eastwood, Notts.

Question 2. (E.)—State the form, weight, and best mode of laying underground rails.

Answer.—The form, weight, and method of laying rails for underground transit varies in different districts. The forms in use in this district are:—The "railway metal" type for main haulage roads, weighing thirty-six pounds per yard, four yards in length, fastened together by fish plates at the joints. The best method of laying these rails for a permanent road is to level the road with small cinders brought from the furnaces, where furnaces are used for producing ventilation, or from the boilers situated on the surface. The sleepers are laid level at a distance of two feet apart, the rails being fastened to them by two-inch spikes, and at the joints by fish plates, which keep the rails in a straight line with each other, so that the wheels of the tubs will not strike them. The rails are laid as straight as is conveniently practicable so that the tubs may be run at a high rate of speed, if required, without any danger of running off the rails, and thereby causing considerable delay. The way in which the rails are put straight is is follows: A sight is taken along the level or brow, whichever the case may be, and lines are hung from the roof, about twelve yards apart, and weighted at the ends; an horizontal line is then stretched from one vertical line to the other, usually over the top of the rail, and one line of rails are put straight with this, the other line or lines of rails being put parallel by means of a guage which is twenty-seven inches between. The rails in use for temporary roads, such as the roads by which coal is brought from the working face to the main haulage roads, are the "bridge rails" weighing from ten to fourteen pounds per yard, two yards long, and laid on to sleepers, one under every joint and one half-way between, in fact one every yard, and nailed together with two-inch flat-headed nails. Where the roads are soft and wet sleepers are laid about every two feet apart, and longitudinal battens are placed on these sleepers, and the rails are fastened on the battens.

THOS. BANKS,
7, Church Road,
Haydock.

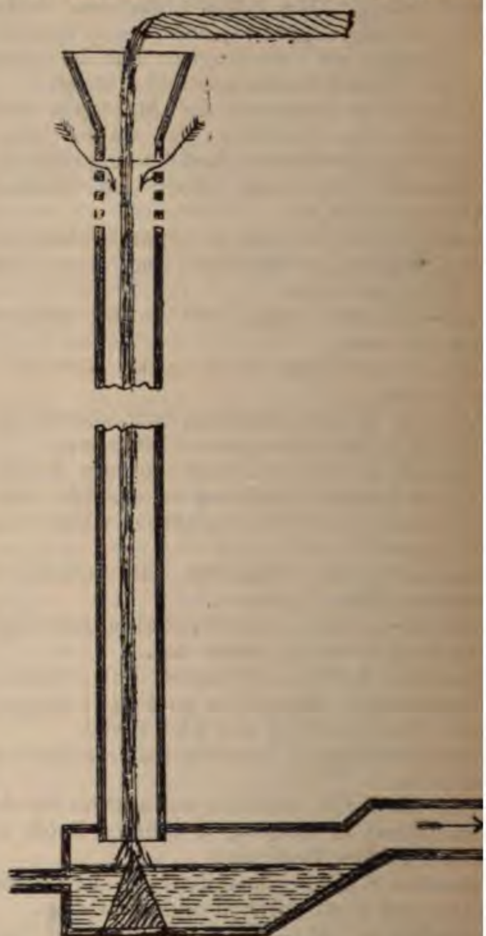
Question 3. (E.)—State exactly the inclination or gradient (assigning reason for it) which should be given to the main levels of collieries.

Answer.—A suitable inclination is one-quarter of an inch to the yard, out-bye or with the load. The reason for the above that it is just sufficient to overcome the for exerted by gravity, therefore it requires or a minimum of power to move the load, th is, to haul the empties in-bye and the f load out-bye. It is also sufficient to dra the water to the shaft.

ALEX. ANDERSON,
26, Havelock Street,
Felling, R.S.O.
Co. Durha

Question 4. (A.)—How has the ventilati of a mine been produced by falling water.

Answer.—The ventilation of a mine may produced by falling water as shown in t accompanying sketch, which is an illustrati of a water trompe. It will be seen that t



water enters the top of the pipe, and that little below the top of the pipe small holes perforations will be seen. The water entering the top of the pipe is broken in spray by means of cross bars or a wire me

and in passing down the pipe it produces an exhaustive effect, when the air rushes in through the perforations. In this way the air is trapped and carried by the falling water into the mine. The water falls into a suitable tank, while the air is liberated and conducted through the working of the mine. This method answers very well for small mines in hilly districts where plenty of water can be procured, and when the water can be run out of the mine by means of an adit level, but if the water has to be pumped to bank again, then a more efficient ventilation would be produced with the same power applied to a fan. In cases where the ordinary ventilating appliances may have been deranged, as in the case of an explosion, then a waterfall proves useful until the ordinary appliances can be restored to working order again.

BENJAMIN NIGHTINGALE,
Ryhill, near Wakefield.

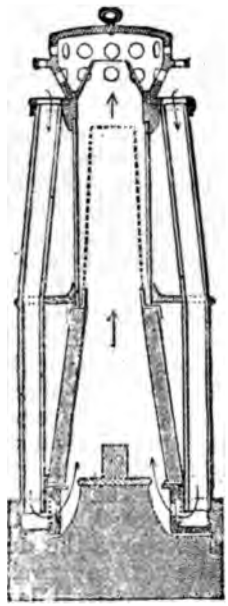
Question 5. (A.)—What do you know about ascentional ventilation?

Answer.—We know that ascentional ventilation is the taking of the in-take current at once to its lowest level in the mine, and thence leading it through the workings of the mine in an ascending direction. This principle is only applicable where the seams have a considerable inclination. It is based upon two considerations. FIRST:—The in-take urrent is supposed to be always cooler than the return: its temperature is gradually raised as it passes through the workings. The air current has therefore a natural tendency to ascend whilst passing through the workings, and by making the direction of the current to coincide with this natural tendency the current is materially assisted by the latter, whilst in the reversed direction it would be opposed by it. SECOND:—In mines containing fire-damp (this being lighter than air) it will tend to rise, and if the air current is ascentional this tendency will help the air current to remove it, whilst, on the other hand, if the direction of the current be downward the natural tendency of fire damp to rise will oppose its removal by the air current. In highly-inclined seams where there are numerous connections between the levels, this principle must be carefully observed, or there will be a great loss of air. Exhaustive experiments have been made in Belgium to ascertain the advantages of ascentional ventilation, and it has been demonstrated that the loss of air, where attention is not paid to it, is from 33 to 50 per cent.

J. H. RONTREE,
Spark Lane,
Mapplewell, nr. Barnsley.

Question 6. (A.)—Describe the Hepplewhite Gray's deputy lamp.

Answer.—The Hepplewhite Gray's lamp, although rather heavy for general use is especially useful for gas testing. Its construction (see sketch) has been approved of and selected by the Royal Commissioners as a comparatively safe lamp. It can be fed with air either from the top or bottom of the lamp, or from both. The air enters the four tubes and passes through a gauze before impinging on the flame. The top of the glass is surmounted by a conical gauze, which is surrounded by a shield to protect it from the outside atmosphere. The products of combustion pass up through holes at the top of the lamp. When gas testing, the holes in the lower part of the lamp are closed by means of slides, and all the air entering the lamp passes through the four holes at the top; hence if only a thin stratum of gas exists near the roof, it will pass into the lamp and show itself.



ROGER BANKS
7, Church Row,
Haydock.

Question 7. (H.)—What quantity of coal dust do you consider would accumulate in a main haulage road twelve feet by six feet, in a dry and dusty mine, through which five hundred tons of coal are drawn daily?

Answer.—The above question is rather indefinite as it does not state whether the main haulage road is the in-take or return airway, the velocity of the air, nor what system of haulage is used. Now these are important factors in determining the quantity of coal dust accumulated in the main haulage roads. For instance, if the main hauling road was in the in-take airway and the main-and-tail rope system of haulage used, it would be more favourable for the accumulation of coal dust than if endless rope haulage was used in the return. In the case in question, we will take the main in-take airway with main-and-tail

rope haulage. The area of the road is 12 feet × 6 feet = 72 square feet, but the tubs will take about 12 sq. feet, so that the available area for the air will be 72 — 12 = 60 sq. ft. Now, suppose we are producing 50,000 cubic feet of air per minute, and the tubs are travelling at the rate of five miles per hour, the velocity of the air will be 833 feet per minute, and the tubs 440 feet per minute, so that the air will pass over the tubs with a velocity of 1273 feet per minute. Large quantities of dust are thus blown from the tubs, the heavier particles settling on the floor, and the other on the roof and sides. It is the latter which is the most inflammable. The floor is cleaned at intervals, but that on the roof and sides is sometimes allowed to accumulate to a great thickness. Mr. W. GALLOWAY states that one pound of this dust in 160 cubic feet of air is inflammable. In the case we have under consideration this would mean one pound for every 2½ feet in length of the road. For my own part I think that much larger quantities than the above may be commonly found on the roof and sides (without considering the floor) of main hauling roads. In this case, with the conditions as above stated, where the dust was allowed to accumulate for, say twelve months, I should say there will be at least four pounds for every lineal yard. To counteract this I should keep it in a state of saturation by means of watering, or otherwise keep the road scruplously free from dust. A good plan would be to keep the road, in lengths of 150 yards, perfectly free from dust, as in the absence of gas the flame of an explosion would not be likely to extend over this distance without a supply of some combustible to feed the flame.

JOHN WORRALL,
21, Wigan Road,
Westhoughton, Lanc.

Question 8. (H.)—How is the air through a mine affected by friction?

Answer.—Friction is the resistance offered to the air in its passage round the mine, and the amount of frictional resistance is estimated by the force required to overcome it. The three laws of friction are:—(1) the resistance due to friction varies directly as the extent of rubbing surface; (2) inversely as the sectional area; (3) and directly as the square of the velocity. In the first case, if we double the length of the airway we also double the friction, or if we reduce the length we also reduce the friction, and consequently the force required to overcome it. In the second case, if we increase the area of airways we reduce friction, or if we lessen the area of airways we increase friction. In the third case, for a double velocity of air in the same airway we have four times the friction, and for three times the velocity nine times the friction, and so on. If we halve the velocity we should only have one-fourth the friction. Hence it follows from the above laws that to reduce friction to a minimum we should endeavour to make the airways as short as possible, the sectional area as large as possible, and the velocity as low as circumstances will allow. The roughness or uneveness of the airways greatly increase friction, so that the more straight the airway the less is the friction offered to the air. A co-efficient is usually allowed for this, and the pressure required to overcome friction varies directly as the co-efficient of friction. The average pressure required under ordinary conditions is ·26881 feet (*Atkinson*) of air column of the same density as the current.

ALBERT HART,
173, Kiveton Park,
near Sheffield.

Question 9. (M.)—Explain what would occur if a mine giving off much gas was worked by longwall, with the face advancing towards the dip.

Answer.—In a mine giving off much gas, the face advancing towards the dip makes it much more difficult to keep the goafs clear of fire-damp. As fire-damp is lighter than air it has a tendency to rise to the highest point, which, in this case, would be the goaf. Now, to prevent this would require a good current of air. The packs should be kept solid from drawing road to drawing road, and never more than four to eight feet from the face, so as to carry the gas away as it is given off. If sufficient dirt be not at hand, I would keep a current of air passing through the goaf, and not allow it to enter the working-places afterwards.

WILLIAM PILKINGTON,
324, Church Street,
Westhoughton,
near Bolton.

Question 10. (M.)—Describe in a general way how you would ventilate a colliery, and state under what conditions the fan, furnace, or natural ventilation could be most advantageously employed with respect to the volume and cost of air produced.

Answer.—The following circumstances must be taken into deliberation in considering the matter and forming a decision, viz.:—(1) The

depth of the shafts; (2) The nature of general strata, roof, thill, and the physical character of the coal; (3) The area or extent of the Royalty, and the inclination of the seam or seams. These are the chief and most important points in deciding what system, and how best, to ventilate any colliery. In all cases we must remember that there must be an intake and return air road, and coal seams are almost exclusively ventilated by multiple currents or splits. Practical ventilation really is the distribution of the ventilating current, and this is effected principally by splitting the main currents into as many splits as would be practicable, so as to keep the mine as cool as possible, and to remove all gases to the return as direct as possible. The advantages of this system are very great when contrasted with the mode of ventilation in the time of Mr. SPEDDING. I would have my airways as large as possible so as to keep the velocity down near to about ten feet per second if possible. My object would be to have an efficient amount of ventilation kept and maintained, and no loss of out-put. This will counter-balance the cost of making and keeping the airways in good order. The question refers to the adoption of fan, furnace, and natural methods of ventilation, viz.:—(1) Natural ventilation, which is of a primitive character. This system is carried on where the up-cast and down-cast shafts are of unequal depth, the deeper shaft being the downcast. This mode is quite inadequate on account of its feebleness and liability to derangement by varying changes in the atmosphere at the surface. (2) For deep pits some mining engineers often prefer the furnace to the fan, especially when the shafts are dry, and where steam boilers are used in the mine, but any additional advantage secured by the furnace when aided by the heat from the boilers and exhaust steam would be equally an advantage in every way to the fan. All things considered we think, in the near future, the fan will (and does) replace the furnace. Practical men are agreed that the fan is decidedly the best, cheapest, and most reliable in every respect. There is no danger from underground fire (as caused by the furnace); no danger from damaging the ropes, wire conductors, pumps (if any), signal wires, tubbing, &c. With the fan you can increase or decrease your ventilation at will. My preference for adopting the fan is on its small score of cost; either the *Capell*, *Guiball*, *Scheile*, or *Waddle*, these being the leading fans in the market.

SAMUEL DAVIES,
New Co-Op. Houses,
Mapplewell, near **Barnsley.**

ANSWERS TO CORRESPONDENTS.

W. S. (Kilmarnock). — Contribution received, will insert in course of a few weeks, as soon as space will allow. Will write you.

R. S. (Barnsley).—If you are three numbers short, and wish to have a bound volume, send the numbers which you have and we will complete the volume at a charge of a penny for each issue required.

CORRESPONDENCE.

Tow Law,
October 25th, 1893.

To the Editor of "Mining."

Dear Sir,

I notice in your last issue (No. 24) a Correspondent takes objection to the suggested amendments to the C.M.R.A., as stated in my answer to question 12, in No. 22, but which, through lack of space, did not appear until No. 23 issue. Sir, I must say that I think your Correspondent to be devoid of that good feeling and fraternity which up to the present time has characterised the readers of your valuable Journal; nay, I am sure that "Newcastler" has been prompted by no other motive than that of criticism. He reminds me of a schoolboy "throwing stones," who first takes the precaution to fortify himself behind a wall. I am sorry that so much of your valuable space has been sacrificed to promote his designs. If "Newcastler" had been a searcher after truth, or had he wrote in a spirit of inquiry, he would not have been ashamed of his name appearing at the foot of his interesting letter. Had he done so, I should have felt that a clearer explanation was due to him.

Sir, "Newcastler" evidently is an enemy to that which ought to be the motto of every reader of your valuable Journal, viz.: "Progress and Improvement," as he seems to consider the C.M.R.A. already perfect. He suggests that I do not know General Rule 4. Well sir, I must say that "Newcastler" himself has shown a lamentable amount of ignorance of that same Rule. He seems to have read only a portion of the Rule, and I should advise him to read on until he has completed both clauses. Again, as a Rule, "inquisitive

anonymous Correspondence" ought to be treated with silent contempt, as unworthy of notice, but I shall take exception to two statements which "Newcastler" makes, which may tend to mislead some of your many readers. I refer to those paragraphs in which he speaks of (1st) Reports of Examinations, and (2nd) Finding of Firedamp. 1st. "Newcastler" makes a mistake when he says "that a report of each shift or examination is made and signed by the person who made the examination." In case of a colliery worked on the single-shift system, the C.M.R.A. requires a written report of every shift or examination. "Newcastler" is evidently a stranger to the fact that there are collieries worked by "two or more shifts succeeding one another without any interval," where the first examination only is reported, and yet the Act is complied with.—"Newcastler" inquires "where?" and echo answers "where?" 2nd. I should like "Newcastler" to refer to the Abstract of the C.M.R.A., paragraph 42, sec. 51, where he will discover "that each mine must have its own set of Special Rules framed to meet the special circumstances of the mine." These Rules do not always require the immediate reporting of the presence of firedamp to the person in charge of the district. "Newcastler" evidently does not know that the Special Rule mentioned by me in my answer is one which belongs to another county. I hope that if "Newcastler" comes again into print, that he will act a *manly* part, by "coming to the light."

I apologise, Sir, for trespassing so much upon your valuable space, but I am sure its insertion is due not only to myself, but to all the readers of your Journal.

Wishing "*Mining*" every success,

I am, Sir,

Yours respectfully,

THOMAS BEST.

Suggested Amendments of the C.M.R.A.

To the Editor of "Mining."

Dear Sir,

Allow me through your columns to compliment Mr. THOS. BEST, of Tow Law, Durham, on his suggested amendments of the C.M.R.A. I think these amendments are highly desirable, especially in the case of competent deputies, and the packing of a jury in case of inquest on fatal accidents. I have myself heard the most absurd and ludicrous questions asked or put to witnesses at inquests, which to my mind prove that local tradesmen, backed by the colliery policeman, were totally ignorant of plans and sections of a place in a mine where a fatal accident occured. How, Sir, can any man decide a point at an inquest who has no technical knowledge of a mine, or who is obviously unacquainted with the existence of a C.M.R.A.

In your last issue (No. 24) I see your correspondent "Newcastler" resents any interference with the C.M.R.A. as being unnecessary and uncalled for. He sets Mr. BEST's practical mining experience at nought, and says he shonld like to know where the requirements of the Act as regards deputies examinations and reports have not been carried out. I may, for "Newcastler's" edification, inform him that I am personally acquainted with men acting in the capacity of deputies who are quite illiterate; how, Sir, can those men be competent to fulfil the requirements of the C.M.R.A. Another instance of incompetency occurs to my mind; a colliery not twenty miles from the "canny toom" (Newcastle), had occasion to change its manager. The new manager, within ten days of his installation, gave three deputies notice to leave the colliery or take up some other kind of work, they being illiterate and incompetent, and yet, Sir, those very men had acted in that capacity for years.

"Newcastler" thinks that a manager is not the one to appoint anybody that is likely to be incompetent or negligent. Let me again inform him that I am personally acquainted with men who never worked in or around the working face for six successive days, recently appointed as deputies. How, Sir, can those men be competent persons?

Now, Sir, in conclusion I ask "Newcastler" where does the present C.M.R.A. provide against the appointment of incompetent persons as deputies. Surely not anything defined in General Rule 4. I trust that we, as deputies, will agitate these questions of incompetency and C.M.R.A. amendment, and not stand aside and be content to suffer through the appointment of incompetent persons. Thanking you in anticipation,

Yours,

"Durhamer."

NOTICES.

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